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ANNOUNCEMENT CONCERNING BACK NUMBERS.

The publishers of this jonrnal have heretofore endeavored to keep on hand indefinitely a supply of the separate numbers of back volumes. Experience shows that there is very little demand for such numbers more than a year old, while the trouble involved in keeping them is wholly out of proportion to the value of the accommodation to subscribers. It has been decided, therefore, to keep separate copies for but twelve months back of the current issue. Orders for issues prior to May, 1904, should be sent in immediately, as the stock on hand will be disposed of at an early date. Bound back volumes will, however, be kept on hand as heretofore.

MASSACHUSETTS CENTRAL STATIONS.

Elsewhere we give a brief resume of some of the more interesting features of that part of the 1904 Report of the Massachusetts Gas & Electric Light Commissioners which deals with central electric lighting stations. To those who would make a study of central station finances, we commend the annual issues of this admirable document, with its array of figures dealing with the business side of the industry. In the absence of similar reports from other states it cannot be asserted that the central station situation in Massachusetts is better or worse than elsewhere in this country. In view, however, of the shrewd business characteristics of the people of the Bay State, it can probably safely be assumed that the situation of the industry in Massachusetts is not less favorable than in other parts of the country. Moreover, no peculiar conditions prevail as to character of plants or communities served, the plants graduating down regularly from that of a great city to the modest installation of a country town. If, then, the Massachusetts situation may be taken to represent the central station situation in general of the United States, the showing for the national industry is none too satisfactory, and certainly does not bear out those who would believe that central stations are a source of exactions from the public.

The net result of the year's operation for all of the electric plants in the State is a deficit of $465,442 as against a deficit of $99,828 for 1903, notwithstanding a gain in income of about $250,000. Unfortunately, the details of this deficit cannot be determined, being submerged in an entry of "Sundry Items," which increased from $500,835 in 1903 to $3,008,214 in 1904. An examination, however, of the individual statements of companies shows that this item consists largely of reserves in the hands of the larger companies, doubtless for improvements and extensions of plant. To apply another criterion, of 56 companies reported, 26 did not earn sufficient to pay dividends, and one company did not earn expenses. Of the companies declaring dividends 17 paid 6 per cent. or less. Most of the larger plants paid dividends ranging from 7 to 10 per cent., the smaller plants being those making the unfavorable showing. In other parts of the United States it is the plants of the latter class which are particularly menaced through municipal ownership, and it would be instructive to those favoring this principle to make a study of the Massachusetts statistics. They would there learn not only of the small profit, if any, which accrues to private ownership of small stations, but would also have at their service the actual figures of municipal plants to check against the claims as to the cost of operating such plants. In fact, there is scarcely any doubt that if every State were to publish the accounts of central stations as it is done in Massachusetts, a very decided check would be given to the municipal ownership movement.

WATTMETERS ON THREE-WIRE SYSTEMS.

As ordinarily inserted in a two-wire, direct-current system, a single watt-hour meter may be caused to register accurately the energy consumed. It is evident that, owing to the construction of the meter, the readings depend upon the product of the electromotive force across the shunt coil and the current in the series coil, and that the meter will be unable to distinguish between the various sources of the volts and the amperes. For three-wire installation, a self-evident method of measuring the energy is to use two watt-hour meters, one for each side of the system; if the potential and current coils are introduced in the circuit in the conventional way with the current coils in the outer leads, the meters will register correctly. Such a method involves the use of two meters for each consumer, and is to that extent objectionable. In order to employ a single meter for a three-wire system, the essential driving elements of the two meters, as above indicated, may be combined so as to act against a common retarding device, and to register their combined efforts on a single dial. The commercial form of the single meter is such as to utilize a single resultant magnetic field due to the two currents in the two outer leads acting in combination with a separate magnetic field of a strength proportional to the voltage of the circuit.

The article by Mr. L. A. Freudenberger, on page 717 of this issue, gives a clear demonstration of the relative errors of the three possible methods of interconnecting the circuits of the meter with those of the three-wire system. If the two component voltages of the system are equal at all times, it matters not whether the shunt (armature) coil is connected across the two outer leads, or between an outer main and the neutral wire, the shunt-circuit resistance being properly proportioned in each case. When, however, a difference exists between the electromotive forces of the two circuits, a considerable error is produced when the shunt coil is across the higher or the lower voltage; and when it is subjected to a mean of the voltages by being connected across the two outer mains absolute accuracy is obtained only when the current in the neutral wire is of zero value. As pointed out by Mr. Freudenberger, when the mean voltage is used, the error is less than when either the higher or the lower voltage is employed; that in commercial work the errors would be of both positive and negative values and the final result would be more or less accurate. It is apparent, however, that for the entire elimination of errors, the driving mechanism should consist of two elements each containing a series and a shunt coil connected in circuit as though each were a separate wattmeter, only the retarding and the registering devices being common to the two meters thus formed.

SOME DIFFICULTIES IN COMMERCIAL PHOTOMETRY.

On its face photometry is a comparatively easy matter, but the more one has practically to do with it the less simple and exact it appears to be. For years it was impracticable to get standard incandescent lamps of a satisfactory character, and even now when several sources of such secondary standards are available, it is not so easy as it might seem to get two standards which are in accurate agreement. As to primary standards, the case is still worse, for while the Hefner lamp is fairly determinable it still lacks much of being convenient, owing to its low power and strong reddish tinge. The legal standard candle is in worse case, and the Violle platinum lamp, beautiful as it is in theory, hardly fills the bill. If one wants on short notice to determine, for instance, the candle power of a few incandescent lamps with reasonable certainty as to their absolute light value, he finds himself up against a tough job, much tougher than he would suppose. If the lamps are arc lamps, a new crop of troubles springs up like Jonah's gourd. If only approximate values are necessary, the task is much easier, but even so the color difficulties are serious. Assuming the possession of good standard incandescent lamps, it is far from easy to be certain that they are what they seem, especially if they have been in use by students to whom caution has not yet become second nature. The voltmeters used must be assumed to be incorrect, as even the best of them are likely to be when precision is the order of the day, and recalibration is in order at the very start. This accomplished, the real sorrows of photometry are just ready to begin.

Their source is the basic fact that photometry involves physiological variables which are likely to break in upon the experiments in a most inconvenient manner. It is, of course, a fact that a trained observer will set a Bunsen or other photometer screen with a very good degree of precision, so that the "probable error" of a set of observations will be of a most encouraging size. But small probable error does not imply exactness—only consistency. The "personal equation," as astronomers call it, comes into play in photometry to a very disconcerting degree. The balancing point of a screen, be it ever so sensitive as an indicator, depends upon the way in which the eye sees it, and this is even for the same observer a rather uncertain variable. As the eye gets tired it sees things differently; even a little straining of attention has its effect. In other words, while a single observer may set the photometer down to half a per cent. in a single series of observations, it is almost certain that if he comes back next day, readjusts the apparatus and tries it over again, he will again get numbers, consistent with themselves perhaps, but not in good agreement with those first obtained. If more than one observer is at work, the mean of the readings for any one day probably will not agree with the mean for another day within several per cent. It is quite true that observers regularly doing photometric work day after day seem sometimes to work very closely, but does the agreement mean real precision? Even the method of substitution generally employed is not a complete protection against personal equation, for it tacitly assumes that the personal equation is constant, which it certainly is not. In the observatory elaborate contrivances for checking personal equation are in use and the peculiarities of each observer come to be well known, but in photometry these peculiarities are seldom or never properly investigated. In rough testing these refinements are needless; but when, for example, one wishes the candle power of an incandescent lamp to three significant figures, the elimination of personal errors becomes a very serious matter.

The relation of such errors in comparing lights of different colors is a matter of still greater uncertainty. It strikes us that the personal equation in photometry is a subject of investigation that could very profitably be taken up in some of our engineering schools, extending the research to many observers and to many forms of screen. It is by no means certain that the screen which permits the greatest exactness of setting will also tend to keep down the personal errors, especially in comparing colored lights. Many comparisons between different forms of screens have been made, but we know of no investigation which has furnished an adequate answer to the questions here raised. The practical side of the subject is somewhat as follows: Given two lamps of slightly different voltage and efficiency, compared, let us say, at the National Bureau of Standards, with all attainable precision. Now let these be sent in succession to ten well-equipped laboratories, without marking them except with the voltage of rating, and at each of these let the lamps be checked by five observers against each other and against the laboratory standard, whatever it may be. How much variation will appear (a) in the ratio; (b) in the reputed absolute candle power? We think the Bureau of Standards could very profitably undertake such a study of the conditions of precision in photometry, and we have a lurking notion that some of the results would be rather shocking. At least the study would have the result of showing the

degree of precision to be expected in the careful use of well authenticated secondary standards. In a purely commercial way it would give an idea of the latitude to be allowed for in sampling a lot of lamps for acceptance. If the specifications are at all rigid, knowledge of the reasonable precision to be expected in testing is highly important. More than this, such a study might lead to greater care in the calibration of instruments and in the construction and use of photometric apparatus, and perhaps to a wider knowledge of the personal equation "than is now available." The more exhaustive such tests the better, and we fancy that engineering schools would gladly co-operate in a work of such evident value to the art.

Magnetic Alloys of Non-Magnetic Metals.

It was always supposed until quite recently that the property of magnetism was limited to a certain small number of elementary substances. It was believed that the atoms of iron, nickel and cobalt were inherently magnetic. They were born magnetic, as it were. Just as magnetism was the inherent birthright of these three magnetically noble metals, so no ordinary metal could aspire to the property. Just why the famous three metals just mentioned possessed magnetism as a permanent atomic property, is, of course, a moot point. There is a certain fundamental relation between electricity and magnetism enuntiated by stating that whatever the one is, the other is the curl of it. That is, the two are mutually related as are linear movement and vortical movement in an incompressible fluid; or, as are compression and shear in a perfectly elastic substance. In crude analogy, the mutual relation is like that of the advance of a screw to its twist. If electricity is a flow of ether, then magnetism would be a twist in ether; or vice-versa. This much appears to be admitted. But whether electricity is the flow or the twist of ether and whether it is static or dynamical, are matters open to debate and elucidation. If magnetism be a flow of ether, then it is conceivable that atomic structures consisting, say, of several central positive suns and a large number of negative planets, rapidly revolving around them, might form a whirlpool in the ether, or a vortex-ring structure, in which ether would be perpetually flowing in at one side and flowing out at the other. An atom of iron might be imagined as a sort of steadily revolving microcosmic blower, sucking in the ether on one side—its south pole—and expelling the ether on the other side, its north pole. In a frictionless ether this vortex-ring action might continue indefinitely without expenditure of energy. Under such circumstances it is conceivable that the property of magnetism in iron atoms would be both inherent and perpetual.

It is also known that iron, nickel and cobalt are very close to each other in their atomic weights, these being 56, 58.7 and 59 gramme-atoms respectively. The nearest elements in atomic weight to these are manganese at 55 and copper at 63.6, neither of which elements has individually any appreciable magnetism. It is a suggestive circumstance that the only three inherently magnetic metals should approximate so closely in their atomic weights. It would seem as though at or about this atomic grouping, the peculiar dynamic qualities pertaining to *external* magnetic action became possible. A few elementary substances, such as bismuth, are known to have inherent diamagnetic, or negatively magnetic, properties and traces of magnetism have been found in a number of others. These, however, have been so feeble that some observers have held the belief that the effect was due to traces of iron in the test pieces, existing as impurity. Recent researches have, however, brought to light the fact that alloys of non-magnetic metals may possess magnetism in a marked degree. This upsets all our ideas concerning the divine rights of certain royally magnetic atoms to the exclusive exercise of these prerogatives. But the loss of dignity which the inherently magnetic metals suffer by the discovery is more than compensated for by the increase in interest which the phenomenon of magnetism thereby receives. Manifestly, if our notions of the permanence of atoms are correct, magnetism is no longer to be confined to atomic structures. It may be possessed by molecular groupings of atoms. In fact, it becomes open to doubt whether the property is atomic, after all, and whether it may not be possessed by iron, cobalt and nickel, by virtue of the capacity possessed by their atoms for forming certain specific structural groups of atoms—molecular arrangements—in which the required static or dynamic conditions of the ether may be fulfilled.

Our esteemed contemporary, the *Elektrotechnische Zeitschrift*, published in its issue of March 2nd last, an important article on magnetic alloys of non-magnetic components, according to the researches of Dr. Heusler, who has discovered that alloys of manganese, copper and aluminum are strongly magnetic; that is to say, they are far inferior magnetically to iron, but are quite comparable with nickel. It is interesting to notice that manganese and copper are, as above mentioned, the two metals that come nearest in atomic weight to the iron-nickel-cobalt group. Nevertheless it is indicated in the article referred to that the more important ingredients in the alloy are manganese and aluminum, and that the best results have been obtained with a proportion of these, the same as that of their respective atomic weights (55 to 27.1, or about 2 to 1). The greater the proportion of this Mn-Al association in the upper alloy, the stronger the magnetic property attained. If, however, the Mn-Al association exceeds 40 per cent. by weight, the alloy becomes too hard and brittle to work mechanically.

Two samples of this wonderful alloy are described in magnetic detail, the first containing nearly 40 per cent. of Mn-Al association and 60 per cent. copper, the second containing about 30 per cent. of Mn-Al association and about 70 per cent. copper, with, however, 1 per cent. of lead thrown in. The first sample was almost unworkable mechanically, and, after being ground into the required cylindrical shape for testing, later broke into halves. The second sample was machined without difficulty. The first sample developed a flux density of 4.5 kilogausses at 150 gilberts-per-cm, with a remanence of 2.5 kilogausses and a coercive force of 7 gilberts-per-cm. These conditions correspond fairly to those found in annealed nickel wire. Neither heating to + 110° C. nor cooling to — 190° C. materially affected the magnetic behavior of this sample. The second sample of lower manganese composition at first developed less than 2 kilogausses; but after being kept for some three weeks at a temperature of 110° C., the flux density increased steadily to 3.2 kilogausses at 150 gilberts-per-cm. The coercive force fell at the same time from 1.7 to 1.0 gilberts-per-cm. This long annealing process nearly doubled both the flux density and the remanence, but nearly halved the coercive force. At 165° C. the magnetic behavior was distinctly inferior. At moderately high temperatures it is said to disappear. From a practical standpoint, the new magnetic alloys have as yet no importance, because they give thus far at most only 5 kilogausses against 18 kilogausses in soft steel. Nevertheless the hope is awakened of ultimately discovering an alloy that may compete with steel. An alloy of high magnetic conductivity, high electric resistivity and high mechanical elasticity would greatly simplify and cheapen the building of dynamo machinery, permitting field and armature structures to be cast instead of laminated. From a theoretical standpoint, the discovery of magnetic alloys is most valuable. It not only alters and extends our conception of magnetism in metals, but it also offers new facilities for the study and comprehension of the law of alloys and metallic solutions, a most important but most obscure subject. Every new phenomenon of this character helps in the great task of finding clues to the problems of matter, ether and electromagnetism.

Report of Massachusetts Board of Gas and Electric Light Commissioners.

The annual report of the Massachusetts Board of Gas and Electric Light Commissioners for the year 1904 shows that there were 21 municipalities and 82 companies actively engaged in the supply of electric light on June 30, 1904. Of the 21 municipalities, however, three—those of Belmont, Hingham and Wellesley—have only distributing plants and buy in bulk their electric current. Four other towns—Holyoke, Middleboro, Wakefield and Westfield—operate both gas and electric plants. There are thus 14 municipalities that operate electric lighting plants alone. In addition to the 82 companies supplying electric light, there are a number of plants not owned by corporations, concerning which no statistics are given. According to the tabulations of stations, 56 of the companies operate only electric lighting plants.

In 1904 the total income of all the electric light central stations in the state was $7,663,961, and the total expenses $4,632,043, leaving an apparent net profit of $3,031,918. Of this profit the gas companies made in their electrical departments $515,579, leaving a balance for the companies operating only central stations, of $3,008,214. Against this are charged for interest, $424,739; for dividends, $1,543,875; for depreciation, $199,597; sundry items, $1,305,444. The deficit for the year in the operations of the companies was thus $465,442.

Of the 56 central stations one did not earn expenses, and 26 others did not earn sufficient to warrant the declaration of any dividend. The other 29 stations paid dividends ranging from 10 per cent. in the case of the Boston Edison and Gardner stations, down to 2 per cent. in the case of the Orange station.

The total investment in the 21 municipal plants is $3,113,000. The total assets of the electric companies only are $31,502,196. Of the total income of the central stations, namely, $7,663,961, the receipts in round numbers from commercial arc and incandescent lights were $4,500,000; from public arc lights, $1,470,000, and from public incandescent lights, $394,000. The sale of electric power amounted to $1,208,000. In the total expenses of $4,632,043, fuel figured for $1,108,820, and wages for $556,529. The other large items were plant repairs, $216,000; wages for care of lights and meters, clerical labor in this department and salary or commissions of collectors, $232,609; repairs and renewals of lines, meters, lamps and motors, $481,647; incandescent lamps, $173,901; salaries of officers, $182,993; general salaries, $249,332; general office expenses, $176,042; taxes, $523,027; insurance, $105,698.

The income of the municipal central stations during 1904 was $236,841, and the expenses $321,896, leaving an apparent loss in operating account of $85,055. Adding $61,725 for interest on bonds and notes and $85,851 for depreciation, the total expenditure for town and city lighting was $233,095. The income above given was that derived from the sale of commercial and domestic arc and incandescent lights, electric power and from rent of meters, motors and fixtures.

The capital of the Edison Electric Illuminating Company of Boston is given as $10,444,500. The stock is held by 2,169 stockholders, of whom 1,626 reside in Massachusetts, holding $8,253,500. The plant is assessed at $11,764,100, and the taxes paid in 1904 were $312,089. The capital of the United Electric Light Company of Springfield is $800,000, the assessed valuation $853,500, and the taxes $14,902. The corresponding figures for some of the other larger plants are as follows: Cambridge, $700,000, $798,000 and $15,016; Lowell, $600,000, $509,050 and $22,529; Worcester, $600,000, $966,000 and $18,731.

During the year covered by the report there were 60 fatal accidents from gas, and 6 from electricity, the non-fatal cases being 123 and 15 respectively.

Following is the lighting capacity of all of the companies, neglecting a few odd ratings: 2,000-cp arcs, 10,058; 1,200-cp arcs, 10,248; 16-cp incandescents, 1,301,480; 32-cp incandescents, 7,200. The figures show a decrease in arcs, the numbers for 1902 being 12,179 2,000-cp arcs and 13,238 1,200-cp arcs. In the same period the 16-cp incandescents increased from 1,042,376.

It is stated that official inquiries relative to action about a municipal gas or electric lighting plant were received from 191 towns and cities, including all of the cities and substantially all the towns in which the population exceeds 1,500, and in which no such action had previously been taken. None of these inquiries led to action during the year.

A "Pertinacious" Current.

Sir Oliver Lodge recently delivered a lecture before the Royal Institution, the subject of which as announced was "A Pertinacious Current." It appears from the account of the lecture given in the London *Electrician* that the eccentric professor had chosen to apply this name to a continuous unidirectional discharge of electricity, obtained without cells, and under an e.m.f. so high that ordinary high resistances are easily over-ridden. The necessity of producing such currents by practical methods—that is, by a magnetic method, in contradistinction to the battery method—had been thrust upon the lecturer by his experiments in fog-dispelling, where a high-potential unidirectional discharge is essential. The magnetic method consists in using the mercury rectifier to trap in a reservoir the surges from an induction coil. The rectifier operates like a valve controlling the inlet of a cistern into which water is intermittently pumped. In this analogy the water stands for electricity, the pump for the induction coil, and the cistern for the Leyden jar of the electrical case. It was in the explanation of the internal action of the rectifier the interest of the evening mainly centred.

Sir Oliver proposed the following theory of the vacuum tube rectifier: He believes the current is carried through a rarefied gas chiefly by the positive particles, the electricity conveyed by the negative particles or corpuscles being comparatively small in amount. Anything which hinders the passage of the positive ions increases the effective electrical resistance of the tube. Now, the cathode rays, constituted as they are of corpuscles moving with immense velocities in the direction opposed to the much slower motion of the positive ions, may by the bombardment of the oncoming ions considerably hinder their direct advance. As the vacuum of the tube is increased the plus carriers have increasingly greater difficulty in traveling from the anode to the cathode, and usually manage it only by creeping unobtrusively along indirect paths to those parts of the cathode from which the bombardment is least vigorous. In fact, it is found that the long-continued bombardment of the plus ions, which are probably merely the atoms of the rarefied gas, can drive them right out of the tube and so produce the well-known effect of increasing vacuum. Portions of gas may even be added and driven out in succession in this manner, and when there are no positive carriers left conduction becomes very difficult. To ensure good conductivity, therefore, the positive carriers must be protected from the negative bombardment and must be given plenty of chance to reach the cathode.

This theory was claimed to explain not only the main function of a mercury rectifier, but, besides, the action of that small but very necessary adjunct to the mercury vapor tube—namely, the conducting coating outside the glass round the edge of the liquid mercury which acts as cathode at the bottom of the tube. This conducting Leyden-jar-like coating must be connected to the positive electrode by a wire outside the tube, or the tube is not a rectifier. The explanation of this phenomenon lies in the fact that the conducting coating when so connected establishes through the glass a strong electric field, which diverts the cathode stream from the centre of the vertical tube, thus leaving an open pathway for the positive carriers from the anode above. If the outside terminals be imagined reversed, so that the mercury is anode and the upper iron electrode is cathode, a stream of undiverted cathode rays pours down the tube, stops the upward travel of the positive carriers, and renders conduction extremely difficult. Such a tube of average size will carry about 5 amperes from 100-volt mains when the plus ions move downwards, but practically nothing when they must move upwards.

Further, the theory proposed suggests new and efficient forms of rectifier. One such was described and exhibited by the lecturer. In it advantage is taken of the rectilinear propagation of the cathode rays, when they are free from the deflecting influences of a strong electric or a magnetic field. Here the cathode is a wide stretching vertically the length of the tube. The anode is a smaller electrode, surrounded by a horizontal narrow glass cone or cylinder. In this cone the positive carriers may reside in large numbers, well protected from the cathode ray bombardment, and, as fast as may be, escape from the open end of the cone with a fair chance of reaching the extended cathode. With such a tube Sir Oliver showed an interesting and instructive experiment. Reversing the terminals, the electrode in the cone becomes the cathode, and the negative corpuscles, by their bombardment, quickly eject the positive carriers

from the region. On restoring to the terminals their proper signs an appreciable interval elapses before the tube lights up again in active conduction, showing at once the reality of the emptying process which had been applied to the region round the anode, and, besides, the comparatively slow rate of diffusion of the plus carriers back to their former home.

A number of effective experiments illustrated, during the hour, various applications—ranging from fog-dispelling and Röntgen-tube driving to the burning of a long wet string—of the pertinacious current afforded by Leyden jars kept supplied through a series of rectifiers with electricity from a large induction coil.

Legislative Lighting Investigation in New York City.

The Legislative investigation of the cost of gas and electric light in New York City was resumed on Thursday of last week. It is stated that the investigation will not be completed until the end of next week.

On Thursday afternoon Mr. Henry M. Edwards, Auditor of the company, gave additional testimony about the capitalization of the several electric and conduit companies. Mr. Edwards stated that about 30 per cent. of the current is lost between the generating plant and the customer's meter. The following data were given as the cost per kilowatt-hour of electric current:

	Manhattan.	Bronx.	Yonkers.
Cost of plant	2.40	2.40	4.03
Cost delivered	3.70	3.00	5.10
Cost to consumer	15.00	15.00	15.00

The average production cost of current delivered at Manhattan and the Bronx was stated to be 3.66 cents per kw-hour. Including everything, this figure became 6.32 cents, and the average cost for the last five years has been 7.98 cents. The average income from every kilowatt-hour sold during the last year was 8.04 cents, and for the last five years 9.01 cents. In testifying as to the consolidation of electrical properties, it was stated that the merger of the Edison Electric Illuminating Company and the New York Gas, Electric Light, Heat and Power Company took place in May, 1901. The former company had earned on its capital stock 16 per cent. in 1899, 19.8 per cent. in 1900 and 10.6 per cent. in the four months of 1901. In addition to paying dividends, the company gathered a surplus of $2,800,000. The cost of current to consumers at the time of consolidation was from 20 cents per kw-hour down. The cost of production in 1899 was 5.34 cents per kw-hour, in 1900 5.32 cents, and for the four months of 1901 4.62 per kw-hour. These figures are only for operating expenses, not including depreciation, interest, bad debts, etc.

On Friday Mr. John W. Lieb testified that the net profits of the Edison Company for 1904 were $2,293,839. The company had not paid a dividend, but had a surplus of $6,402,078, and had set aside for depreciation $4,119,233. He said that the company had paid interest for five years of existence on $40,000,000 worth of bonds. The above surplus and the amount set aside for depreciation had gone into the plant.

On Saturday Mr. Arthur Williams, contract manager and general inspector of the company, was examined. Mr. Williams said that the retail rate is 15 cents per kw-hour for the first two hours, 10 cents for the next two hours, 7.5 cents for the next two hours, and after that at the rate of 5 cents per kw-hour. Mr. Lieb testified that 34 per cent. of the current is sold below the retail schedule, and 49 per cent. of the income derived from such sales. In dollars it amounted to $4,371,044 out of a total of $8,991,635 for Manhattan last year. The average income per kilowatt-hour under the retail schedule was 12.27 cents. The rate of 12 cents per kw-hour now charged the city for the lighting of its public buildings, was fixed after Ex-Commissioner Monroe had asked for a uniform rate for all the public buildings. Prior to that time the city had paid at the rate of 13.5 cents.

At the session on Monday of this week, Mr. Williams said that current is supplied to most of the city buildings at 12 cents per kw-hour, the exceptions being the Seventh Regiment Armory, where the charge is 10 cents per kw-hour; Police Headquarters, 7.2 cents per kw-hour; County Clerk's Office, 6.7 cents per kw-hour, and Fire Headquarters, 8.61 cents per kw-hour. The low rate at Police Headquarters was because of the fact that a large part of the current was used in running the elevator. If the city had been treated as the ordinary customer, the current would have cost 13.5 cents per kw-hour. The city, he said, is a poor customer. There are, for example, 47 schools and in these the installation is very large in comparison with the service rendered. In one school alone there are 5,000 lights, but they are only used about two hours a day. The company has a customer in a single building which uses more current than the city does in 95 buildings—47 schoolhouses, 15 firehouses, 4 police stations, and 29 office buildings. The total number of incandescents in these buildings is 37,804. Mr. John W. Lieb stated that to serve 100 buildings would be 100 times more costly than to equip and serve one building. The cost of service connections varied from $50 to $400 per building. In New York there are about 45,000 meters and from 35,000 to 45,000 separate customers. The city for its 95 buildings pays at the rate of 11.36 cents per kw-hour. The company supplied 2,868 arc lights in Manhattan from underground service at 5.4 cents per kw-hour, or $146 for each lamp; and 1,127 arc lamps in the Bronx from overhead service at 7.3 cents per kw-hour. The production cost of supplying the current for Manhattan arc lamps was about 2.9 cents per kw-hour, or 4.6 cents for the current delivered. The profit on those in the Bronx is 2.44 cents per kw-hour. The total profit on arc lighting last year was $116,945. Mr. Edwards testified that the aggregate value of the properties in the New York Edison Company is $81,008,645.

The testimony given on Wednesday, April 12, related mostly to the affairs of the Consolidated Telegraph & Electrical Subway Company. At the beginning of the meeting Mr. Henry M. Edwards, auditor of the New York Edison Company, presented the following figures:

Property of Edison Electric Illuminating Company ($15,259,162.77), less 91,680 shares turned in and cancelled	$6,091,162 77
Property of New York Gas and Electric Light, Heat and Power Company	66,545,100 77
Capital stock of power company taken in	9,040,000 00
406 shares Edison Illuminating stock, at $120,000, exchanged for bonds, which sold for	32,986 06
Total	$81,709,249 60
Now in treasury, 171.7 shares Edison Illuminating stock, which was exchanged for bonds, causing a deduction from the capital account of	20,604 00
Total	$81,688,645 60

Mr. John W. Lieb, Jr., vice-president, submitted the following statement of the cost to the city of arc lighting, cost to the company and the profit for three years.

Year.	Cost to city.	Cost to company.	Profit.
1902	$523,264	$457,364	$65,899
1903	527,060	486,140	40,917
1904	542,828	447,642	95,185

Mr. Lieb corrected in his testimony of Monday, having made an error in stating that the profit for 1904 was $115,00, the correct amount being as given in the above table. Mr. Edwards testified that last year the Edison Company paid the Consolidated Telegraph & Electrical Subway Company $478,722, and received from the company, as interest on bonds held, $268,650.

Mr. William J. Sefton, secretary of the Consolidated Telegraph & Electrical Subway Company, stated that his company started with a cash capital of $40,000. The capital stock was $1,875,000, and there was an expenditure of $732,000 for patents. Examined as to the value of the patents, he stated that only four are now alive and finally admitted that these are practically dead. Stock was issued in payment for the patents and the item is still carried on the books as an investment. Besides the stock issued for patents and for the $40,000 in cash, $1,102,000 was issued for construction. A contract in 1888 was made with the Phoenix Construction Company for the building of ducts. When a final settlement with that company was made on June 3, 1890, it had built 520½ miles of single ducts, costing more than $4,800,000 for which payment was made by issuing bonds consisting of $2,375,000 in first mortgage bonds, and $2,375,000 in second mortgage bonds. The Consolidated Subway Company did not have control of its books from 1890 until three years ago, when they were replevined from the New York Telephone Company, the Phoenix Company having been organized by the telephone company. The balance due to the Phoenix Company was paid in stock and that company got 15 per cent. discount on the bonds. In 1890 the book value of the investment was placed at $5,675,133, but in a report to the Comptroller in 1890 the amount of the investment in construction was given as $8,317,795. The cost of constructing subways in 1898 was $7,627 per mile, and in 1901 $2,000 per mile less. Mr. Arthur W. Middleton explained that the construction account was actually over

$6,000,000, and to this sum was added $1,187,500 for discount on bonds sold which the company would have to redeem at par, and $732,500 for the Johnstone dust patents. Auditor Edwards, of the New York Edison Company testified that the rentals for subways paid by the Edison Company last year amounted to $478,722. In addition to the $2,500,000 of the stock of the Subway Company, which it owns, the Edison Company had lent the latter on debenture bonds $3,373,000 in the past five years. The accrued interest on these bonds is $786,000. The company pays $1,000 per year rental per mile per ducts.

Iowa Electrical Association.

The Iowa Electrical Association, as previously announced, will meet in convention at Dubuque, Ia., Hotel Julien, April 19 and 20. A very complete and attractive programme has been arranged, as given in a previous issue. On April 20 and 21 the Iowa Street and Interurban Railway Association meets at the same place, holding a session on the afternoon of the 20th with the Electrical Association. By arrangements made with the Western Passenger Association, a round trip rate of one and one-third fare has been secured for this convention from railroads in Illinois and Iowa. The members of the Illinois State Electric Association have been invited to the convention, as it is held this year so near to the Illinois line. The supply men from Chicago will go in a body on a train leaving Chicago, on the Chicago Great Western Railway, at 6.30 p. m., Tuesday, April 18, arriving at Dubuque at 11:10 p. m. Those wishing to take this train should notify Walter Goll, Fort Wayne Electric Works, 623 Marquette Building, Chicago. In addition to the programme before published there will be a paper entitled "Gold Brick Finance" on municipal ownership. A feature of the meeting will be an exhibition of the new tantalum lamp, and possibly of another new type of incandescent lamp.

Chicago Municipal Railways.

Mayor-elect Dunne, of Chicago, has applied to the Lord Provost of Glasgow, Scotland, for help in the solution of the municipal street railway problem in Chicago. The manager of the Glasgow city tramway system will leave Glasgow for Chicago before May 10. Judge Dunne spoke in Cooper Union, New York, the night of April 7 on municipal ownership, and the campaign in Chicago which resulted in his election. These are the steps by which Judge Dunne says he expects to bring about municipal ownership:

First, by the appointment of a commission of street railroad experts and eminent lawyers, placing at the commission's head a big man worth a big salary—a $50,000 man—in merit if not in price, raising the money to pay him by public subscription if need be.

Second, by requiring this commission to consider the situation, the value and utility of all present street car properties, and to arrive at a couclusion for the general action, no radical move to be taken prior to the decision of this body.

Third, by making a direct experiment with the line upon which the franchise already has expired, the Chicago Passenger Railway in Adams Street, securing the right to operate by moving Judge Grosscup to release the line from the injunction proceedings which now tie it up.

Fourth, by prosecuting what court actions his corporation counsel and other advisers decide will fit into the "grand scheme."

In the course of his address he said: "Municipal ownership and operation of these [public] utilities and governmental ownership of the railroads, telegraphs and express transportation is a practical question upon which the people must pass within a very short time."

Students' Course at Stanley Works.

The Stanley Electric Manufacturing Company has inaugurated a students' course, to which there will be admitted annually twelve or more students who will be given two and one-half years' instruction covering all of the branches of the company's work, at the same time being paid the highest wages consistent with actual service rendered. The course will be in charge of a committee as follows: Chairman, J. M. Gilmore, foreman testing department; P. W. Power, mechanical engineer; J. H. Noble, assistant manager commercial department; Mr. D. B. Rushmore, electrical engineer, and Mr. W. J. Baughman, superintendent of works.

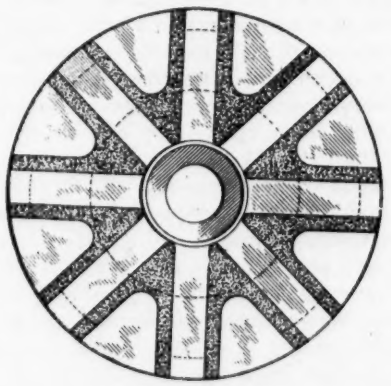
The students will be subject to the conditions of the other workmen with whom they happen to be placed with respect to hours, regulations, piece work prices, overtime allowances, etc. They will not, however, be laid off in times of slack work, and they are not expected to withdraw until they have finished the course. At the conclusion of the course the obligation on both sides will be discharged, the company only employing such of the graduates as it may at the time actually need as engineers or assistants in its various departments.

The wages for the first eighteen months will be 15 cents per hour, for the fourth six months 17½ cents per hour, and during the last months $12 per week, the regular working week consisting of 55 hours. During the first year four months will be given to motor and generator assembly, two months each to switchboard assembly, transformer assembly, winding and installation, and one month each in the annealing building and in inspection. The second year will be spent in the testing department, four months being apportioned to testing generators and two months each to the testing of motors, transformers, instruments and arc lamps. The final six months will be spent either on outside construction work or in the commercial or drafting departments. Applicants for enrollment in the course must be graduates in electrical or mechanical engineering from institutions of good standing.

Magnetic Clutch.

A budget of twelve patents, containing a total of 292 claims, was granted on April 4 to Mr. H. H. Cutler on a form of magnetic clutch and numerous applications thereof. The distinguishing feature of the clutch resides in the means employed for controlling the accelerating torque so as to eliminate the undesirable jerk which is usually associated with magnetic clutches.

The accompanying illustration shows a face view of the magnet member of the clutch. When the magnet is energized the triangular pieces become of one polarity, while the radially-extending pieces are of the opposite polarity, the spaces between the poles being filled with non-magnetic babbitt metal. The dotted lines indicate the location of the magnetizing coil, which is surrounded completely with metal, which protects it from mechanical injury and from any detrimental effect due to oil employed for lubricating purposes. The Babbitt metal affords, with the polar faces, a continuous frictional surface against which bears the other member of the magnetic clutch, the armature. The magnet member is thus so constructed that the energizing winding is entirely surrounded by iron. The large inductance of the winding insures that when the circuit is closed to a source of current the current will rise gradually to its final value without giving to the driven member that sudden acceleration which has been the cause of serious objections to magnetic clutches of the ordinary type. The inventor proposes to utilize both the torque due to friction and that due to eddy currents in the armature structure when there is motion between the two members of the clutch. For a certain magnetizing force the frictional torque is practically constant during the period of acceleration, while the torque due to eddy currents uniformly decreases with increase of speed. By variation of the magnetizing force any torque may be obtained at any



MAGNETIC CLUTCH.

speed up to full synchronism. The subdivision of the magnet into a large number of individual circuits aids in causing a rapid disappearance of the residual magnetism in the armature member when the magnetizing force is removed, and thus allows the clutch to be released practically instantaneously.

Among the several applications proposed for the clutch the ones given greater prominence are for starting synchronous motors, throwing loads gradually upon motors and for the operation of electric vehicles. When applied to an alternating-current motor, the inventor would use a rectifier of either the aluminum or mercury vapor type for supplying direct current to the magnetizing coil of the clutch.

CURRENT NEWS AND NOTES.

TO PRESERVE THE PURITY OF THE TELEPHONE.—The Judiciary Committee of the New York State Senate has reported favorably on a bill making it a misdemeanor to use profane or objectionable language through a telephone.

MR. T. COMMERFORD MARTIN was the guest of honor April 8 at a dinner at the Café Royal, London, England. The committee in charge of the dinner consisted of Mr. R. Kaye Gray, chairman, Sir William Henry Preece and Messrs. W. A. Mordey, Alexander Siemens, James Swinburne, Herbert Laws Webb and Joseph Wetzler, secretary. Mr. Martin will sail for home April 19

WEIGHT OF GENERATING UNITS.—The remarkable difference in weight between turbine and reciprocating engine units is illustrated in the power plant of the New York Rapid Transit Company. The Westinghouse-Parsons turbo-generators with a rated output of 500 kw at 750 r.p.m. weigh 234,000 pounds. Generators of the same output driven by reciprocating engines at 75 r.p.m. weigh 980,000 pounds.

N. E. L. A. CONVENTION.—Mr. Arthur Williams has received for his report on municipal ownership, which is to be presented at the Denver-Colorado Springs convention of the National Electric Light Association, some fifty or more reports from foreign cities and towns, as well as a great quantity of information regarding municipal plants in this country. His report will be very voluminous and forms a notable addition to the literature relating to municipal electric lighting.

ELECTRIC CABS IN BUENOS AYRES.—German electrical enterprise in Buenos Ayres is steadily growing. The latest is the supply of a service of electrical cabs, for which a company with a capital of $1,200,000 is being formed. The service of these cabs will closely follow the example of the highly successful company in Berlin, with taxameter fares, which have everywhere largely increased the number of passengers. One hundred electric cabs will be supplied at the start.

CONSOLIDATION OF GERMAN ELECTRICAL INTERESTS.—A dispatch from Frankfort-on-the-Main, Germany, dated April 10, states that a plan is published for the amalgamation of the Lahmeyer Electrical Company with the firm of Felton & Guilleaume, of Mühlheim. This latter firm takes over the Lahmeyer manufacturing department, the Lahmeyer continuing only as the financing company. The combination will have a capital of $13,750,000. It is thought probable that the combination will later ally itself with one of the great electrical corporations.

NEW YORK CITY TELAUTOGRAPH FRANCHISE.—An application has been made to the New York City Board of Aldermen by the New Amsterdam Telephone Company asking a franchise to lay conduits and erect poles in all five boroughs for the operation of telephones, telegraphs and for telautography. The ordinance provides that the franchise shall run for twenty-five years, but at the end of that time the city shall be empoyered to grant a renewal on a revised basis of compensation. It is provided also that the company for the first term shall pay to the city 3 per cent. of its gross receipts, and shall furnish free telephone service for municipal use.

BROOKLYN POLYTECHNIC INSTITUTE LECTURES.—Dr. F. A. C. Perrine, who returned recently from a trip to Mexico, where he had been called to report on an important water power project near the City of Mexico, resumed his lecture course on hydro-electric engineering at the Brooklyn Polytechnic Institute, on Thursday evening, April 6. The subject discussed was "High and Low Head Hydraulic Machinery." The lecturer began by pointing out the limitations placed on such apparatus when the latter is used in connection with electrical generating machinery, and then took up in detail the civil engineering features of hydro-electric plants, such as the location and construction of various types of dams, the use of canals, wooden flumes, penstocks, etc. Following this a thorough explanation was given of the operating principles and merits of the principal foreign and American type of reaction and impulse water turbines.

ELECTRICAL COMBINATION IN GERMANY.—Consul-General Mason, of Berlin, Germany, in a recent report refers to the combination made in 1903 of the four great German Electrical Manufacturing Companies. They are organized in two groups, each of which assigned to its members the exclusive production of certain kinds of machines, and so apportioned between them and each other the territory to be supplied that the ruinous, headlong competition, which in previous years had led some of the companies to take large contracts for lighting, smelting, and power plants and accept payment in stock of the new enterprises, has been definitely abandoned. The leading German electrical manufacturers are now well on the road toward recovered prosperity. They sometimes accept contracts at prices which would be thought unremunerative in the United States or Great Britain, and one hears of German electrical power plants being set up in Glasgow, Mexico, and in various countries of Asia and South America.

STEVENS INSTITUTE GIFTS.—The conditional gift by Mr. Andrew Carnegie of $50,000 to Stevens Institute is not intended to apply to the "Schooi of Chemistry," as stated in a previous issue, but is for the purpose of increasing the endowment of the Carnegie Laboratory of Engineering at the Institute. In a circular issued February 8 the Institute's most pressing needs were set forth, the amount required to meet them being estimated at $473,500. As the result of a conference at the recent alumni dinner between Mr. Carnegie and President Humphreys, the latter announced that $50,000 had been pledged by Mr. Carnegie as an addition to the Carnegie Laboratory endowment, and another $50,000 pledged by President Humphreys for a students' hall, which amounts would be available as soon as $100,000 of the remaining $373,000 has been subscribed and paid in. In a speech at the dinner, Mr. Carnegie clearly indicated that after the payment of the above $50,000 the Institute must not look to him for furthur help. Including this last $50,000, the gifts of Mr. Carnegie to Stevens will aggregate $340,000.

ENGINEERING AT OXFORD.—The University at Oxford, England, has established a "diploma in scientific engineering and mining subjects," and the committee appointed to arrange the details of the scheme has now issued the regulations concerning the diploma. Members of the University will be eligible for the diploma who have passed at the examinations required for the degree of B. A., and have satisfied the examiners in certain special subjects mentioned in the following list, after an approved course of study in those subjects extending over two years, and have also gone through an approved course of practical training lasting four months, either at a mine or in engineering works. The subjects that may be offered are: (*a*) Mathematics for applied science; (*b*) physics and chemistry; (*c*) French and German translation; (*d*) engineering principles and machine drawing; (*e*) surveying; (*f*) geology; (*g*) mineralogy; (*h*) mining and engineering, hygiene and mine ventilation; (*i*) electricity; (*j*) assaying. For the ordinary diploma candidates will be required to pass in (*a*), (*b*) and (*c*), and in not less than three of the remaining subjects, provided that (*f*), (*g*) and (*i*) are not taken together without one or more of the others. Candidates who propose to become colliery managers and desire to obtain exemption from two of the five years' underground work required by the Home Office as a qualification for a certificate as colliery manager, must obtain a special diploma by passing in the subjects (*a*), (*b*), (*c*), (*h*), and three (not being *f*, *g*, *i*) of the remainder, and by taking their four months' course of practical training at a mine.

ELECTRIFICATION OF THE PORT HURON TUNNEL.—The Grand Trunk Railroad has decided to substitute steam traction in the Port Huron tunnel, in which the terrible accident occurred some months ago. Mr. B. J. Arnold has been retained to report on the system to be adopted and to draw up the final plans and specifications.

EFFECT OF LIGHTNING ON HEART.—A curious case of lightning stroke is reported from St. Joseph, Mich. It is stated that while working as an operator in a telephone exchange, Miss Mabel Rigney, was so frightened by a flash of lightning which coursed along the wires that her heart was displaced. She died two weeks later in intense agony, her heart beats constantly growing more rapid until, just before death, 182 pulsations a minute were registered.

THERMO-ELECTRIC COUPLE.—A patent granted April 4 to A. L. Marsh, for a thermo-couple having a particularly high melting point, is based on the fact that cobalt is electropositive to an alloy of nickel with metals of the chromium group. The positive element may be chemically or commercially pure cobalt. The negative element may be formed of an alloy of chromium ten per cent. and nickel ninety per cent., or of molybdenum fifteen per cent. and nickel eighty-five per cent., or of tungsten twenty per cent. and nickel eighty per cent. No specific information is given as to the melting points of the various combinations.

PROF. WILHELM OSTWALD, of the University of Leipzig, will lecture at Harvard the first half of next year under the exchange recently arranged between Harvard and the German Government. The subject of his course has not yet been announced, but probably he will give one lecture on "The Philosophy of Science," for graduate students. Prof. Ostwald is the founder of the modern school of physical chemistry, this term also including electrochemistry. In recent years he has written much on what might be called the metaphysics of science, dwelling upon the idea that energy is the all-pervading principle of the universe.

ELECTRODE FOR ARC LAMPS.—In order to obtain an arc lamp pencil possessing advantages over the well-known carbon electrode, Mr. I. L. Roberts, according to a patent dated April 4, would employ a tinned iron tube in which is inserted a cylinder of iron wire gauze large enough to fit the tube tightly, potassium chromate or pulverized chrome iron ore filling all of the interstices of the wire cloth. The tube, with its contacts, should be immersed in a solution of caustic soda and then slowly heated until the greater part of the water is expelled as vapor, after which the hydrate formerly in solution will hold the particles firmly together.

CHICAGO TELEPHONE COMPANY'S CHARTER.—An effort to have the courts declare the charter of the Chicago Telephone Company forfeited was begun April 5 by State's Attorney Healy on quo warranto proceedings in the Circuit Court. The matter went over. The attempt to force a forfeiture of the company's charter is based on two allegations: First, that the company has charged $150 and $175 a year for the use of telephones when its franchise fixes the maximum charge at $125; second, that the company has charged toll on telephone calls between points lying within the city limits, in direct violation of the provision of its franchise.

PROF. WOODWARD HONORED.—Prof. R. S. Woodward, president of the Carnegie Institution, was the guest of honor at a dinner at Delmonico's in New York, April 4, given by about 100 of his former colleagues in the Columbia faculty. Mr. Andrew Carnegie was among those present, and made an address. Among his remarks he said: "The great thing about science, education and the like is that all labor goes for the same thing. It makes no difference whether a man is in Columbia, Yale or St. Andrews. So, although we have gotten Dr. Woodward from you, it isn't as if he were entirely separated. Just because of his presence, there will be closer and more beneficial relations between Columbia and the Carnegie Institution. If ever I had any doubt that Prof. Woodward was the man I wanted—and I never had—this gathering would satisfy me. The warm human heart that has caused him to attach himself to his fellows and his fellows to him reassures me. There can be no great success without the esteem of one's fellow men."

SIGNAL RELAY.—To produce an effective signal relay for use with continuous currents which will be responsive to sudden variations and non-responsive to gradual variations of the currents, so that the relay may be adapted to wireless telegraphy, Mr. F. K. Vreeland, according to a patent issued April 4, proposes to employ a mechanism so arranged that a local circuit will be opened or closed by sudden variations of the current passing through a polariphone cell, due to the depolarization of the cell by the signal impulses. The relay is of the suspended-coil ammeter type, and is arranged to move a contact element through a viscous dash-pot, which transmits sudden movements of the motor element to the contact element, but yields readily and without moving the contact element for slow movements of the motor element.

ESCANABA (MICH.) MUNICIPAL PLANT.—Mr. Fred Wildi, superintendent of the City Lighting Plant, of Escanaba, Mich., writes that at an election held April 3 it was voted by a majority of 9 to 1 to continue the municipal lighting plant. In our issue of April 1 it was stated that the common council had decided to sell the plant to the highest bidder. It appears that the finance committee of the city council reported in favor of the sale of the plant on the ground that during the past year it had been operated at a loss of $1,128. It was also held that the plant was antiquated, and that a new plant would cost $50,000. The conclusion of the committee was that the plant should be sold if a price could be received that would return to the city the amount of its investment, and that a suitable franchise be given to the purchaser. They also recommended that the question be submitted to the electors, which was directed to be done by the council, with the result above noted. In an address to the public prior to the election, the superintendent of the plant and the Board of Public Works attacked the report of the finance committee and put forth a claim that instead of the plant losing money it made a net gain of $5,000 during the preceding year.

MULTIPLE-UNIT SYSTEM OF MOTOR CONTROL.—Three patents issued April 4 to Mr. H. H. Cutler have for their common object to provide a new system for controlling the operation of a train of cars upon the multiple-unit plan. The supply of current to each motor is governed by switches operated by electromagnets. These electromagnets are selective in their action, so that in accelerating the motors they will close the switches in the proper order. The selectivity is due to the nature of the windings of the magnets. The windings of the several magnets may be connected either in series and be designed for operation by currents of different strengths, or they may be joined in parallel and be operative by voltages of different values. The reversing switches for each motor and the switches for changing two groups of motors from the series to the parallel connection are separately interlocked, to eliminate any chance of one switch being held closed by residual magnetism while the other was being closed by normal operation of the controller, and to insure proper action of the switches. The variable current or voltage for the electromagnets may be obtained from adjustable points along two resistances connected in parallel across the main trolley circuit, or a special motor-generator may be installed for this purpose.

WIRELESS TELEGRAPHY ON THE FARALLONES.—Work is progressing favorably on the wireless telegraph plant in course of construction by the Navy Department on one of the Farallone group of islands 26 miles west of San Francisco. This replaces the original wireless station that was operated by the Weather Bureau for a year. It had a ¼-hp kerosene engine to operate the generator and was capable of transmitting messages a distance of 30 miles or less. Prof. A. G. McAdie and his assistants deserved great credit for constructing and operating the pioneer station under great disadvantage before any of the naval vessels on the coast were equipped with wireless telegraph sets. At present the battleship *Ohio* and a few other Government vessels use wireless telegraphy, but there are no merchant vessels similarly equipped. The new station on the Farallone Islands will have a 5-hp engine. The water shed is completed and the high steel mast is nearly finished. The difficulties attending construction work on the islands are considerable. The new mast fell once, on account of a guy breaking, two men falling with it a distance of 60 ft. and receiving injuries. On account of the fogs prevailing along shore in the vicinity of San Francisco, the station at these islands will be of great value in reporting the approach of naval vessels as well as merchantmen.

PARIS ELECTRIC LIGHTING.—According to a cablegram, the Municipal Council of Paris has received the report of the Prefect of the Seine laying down the technical regulations for the management of the electric lighting of the city after the expiration of the concessions now in force. There will be installations set up at three power houses outside Paris in different directions, with a minimum capacity of 70,000 kw.

OLD-TIME TELEGRAPHERS' REUNION.—Mr. John C. Barclay, president of the Old-Time Telegraphers' and Historical Association, has appointed committees to prepare for the next reunion, which will take place in New York August 29, 30 and 31, and September 1. An elaborate programme is being laid down for the entertainment of the members. The gathering promises to be the largest in the history of the association.

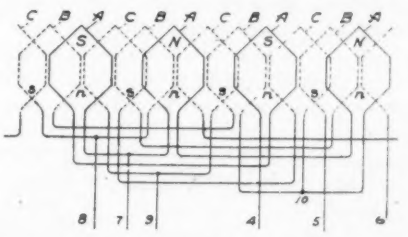
WIRELESS TELEGRAPHY FOR PRESIDENT ROOSEVELT.—It is stated that President Roosevelt will, during his hunting trip in Colorado, keep in constant touch with Secretary Loeb and his official staff at Glenwood by means of wireless telegraphy. The United States Signal Corps will carry out the work. Two expert operators have been detailed to accompany the President into the wilderness. At Glenwood the wireless station will be located on the summit of Lookout Mountain, in a large pavilion. The messages will be telephoned to and from the operator at Hotel Colorado, where Secretary Loeb will have his headquarters.

MUNICIPAL STREET RAILWAYS IN MICHIGAN.—The Legislature of the State of Michigan has refused by a decided vote to submit to the people a proposition to amend the constitution of the State so as to provide for the municipal ownership of street railway lines. While the proposed amendment would of necessity apply to the entire State, it was introduced by a member of the Legislature from the city of Detroit, and was understood to mean that the people of that city would be given an opportunity to vote upon the question of the purchase and operation by the city of the street railway line in the city now owned and operated by the Detroit United Railway. Since the action of the Legislature in refusing to submit the question to a vote of the people, an opinion has been given by the corporation counsel of Detroit to the effect that no amendment of the constitution is necessary to effect municipal ownership, as the city has a right under the present constitution and laws of the State to own street railway lines.

CONTROL OF NEW YORK RAPID TRANSIT.—A bill has been introduced in the Assembly at Albany amending the New York City Rapid Transit Act in very important particulars. One of the main changes is to provide that practically all acts of the commission must be approved by the Board of Estimate and Apportionment. The bill gives the Board of Rapid Transit Commissioners authority to make all rules and regulations affecting the comfort and safety and accommodations for the traveling public in regard to the running of trains, and convenient and fire-proof cars, but then proceeds to fix the rate of fare. It is not to exceed five cents for the first five years, and between 5 a.m. and 9 a.m. and 4 p.m. and 8 p.m. on week days, and on Sundays, legal holidays and Saturdays after 12 o'clock, there shall be two rides for five cents. After five years the commission is not to charge more than five cents for two rides. The bill further provides that the licensee, lessee or contractor shall furnish free rights of transfer to all other local rapid transit roads that may be built and also make traffic arrangements between them. The bill further provides that every plan for construction shall provide for a sufficient space on either side of the railroad for a way of safe egress in case of accident or delay, and that all subways shall be fire-proof and protected against floods, leakage and inundations.

THE TELEGRAPH IN THE PHILIPPINES.—We extract the following from an advance outline of the census of the Philippine Islands, issued by the Census Bureau: "The principal systems of telegraphic intercommunication in the islands were constructed by the United States Signal Corps to facilitate military operations, but were speedily thrown open for commercial and private use. Subsequently arrangements were made for the gradual transfer of the lines to the civil government. There were over 10,000 miles of telegraph and telephone lines and submarine cables in operation, about one-fourth of which were but temporary in character. In addition to the cable system installed by the Signal Corps, a private corporation controls insular marine cables connecting several of the larger towns, and owns the cable system to Hong Kong, formerly used for communication with the United States. The establishment of a direct line from Manila to San Francisco, via Honolulu, has lessened expense and delay. The value of the marine and land lines, controlled by the United States Signal Corps, the insular government and private corporations, was estimated December 31, 1902, to be $1,544,174. During 1902 the Signal Corps employed in the islands an average of 600 men. The telephone facilities consist largely of the military telephone lines under the control of the United States Signal Corps, and the civil government lines operated by the constabulary. In Manila a third system is also in use—a commercial system owned and operated by a private corporation."

WINDING FOR THREE-PHASE MOTORS.—In order to permit of constructing the primary core of a three-phase induction motor with a total number of slots smaller than the product of the number of poles multiplied by the number of phases, Mr. E. F. W. Alexanderson, according to a patent issued March 28, would use coils of such a width with respect to the distance between adjacent coils that each slot may contain two coils of different phases, thereby making it possible to use only one-half the usual number of slots. There are employed form-wound coils, each having a width equal to twice the distance between adjacent coils of the same phase. The coils of each phase are arranged in two groups, alternate coils being



connected in the same group in order that the direction of current may be reversed in alternate coils, so as to vary the number of poles. If in the accompanying illustration 4, 5, 6 are joined to the three-phase supply lines, the smaller number of poles will be produced, while if 4, 5, 6 are connected directly together and 8, 7, 9 are joined to the supply lines, the currents will produce twice the former number of poles, the inter-connections now giving a double-star-wound three-phase machine.

ELECTRICITY IN METALLURGY.—In an address before the Electro-Technical Society of Frankfort, Germany, on the employment of electricity in metallurgy, Mr. De Neufville stated that inventors did not sufficiently consider that electrical energy was always relatively expensive and commercially adaptable only for obtaining highly valuable products from rich materials. In the production of gold from ores large quantities of material, not containing gold, have to be treated, and, therefore, the electric process does not pay. The electrolytic separation of gold from a solution of cyanide of potash, however, is profitable. Electrolytic refining of silver is almost everywhere in use, and refining by acids is still in vogue only where the material to be treated is very rich in gold. Silver is never produced from ores by electrolysis. The greatest interest, he said, still centers in the problem of the electrolytic process for obtaining copper from its ores. Experiments hitherto have not failed on account of technical difficulties, but on account of the expense. Electrolytic refining of copper, however, has given good results, and is much used, especially in America. Two-thirds of the total copper production in America is the result of this process, which in England has not been so largely used. Germany comes next after England, followed by the other European countries. The question whether the multiple or series cell is most preferable has been much discussed. The largest works in America have adopted the series arrangement in spite of certain theories. Electrolysis in late years has also been employed in refining lead where the object was to produce lead entirely free from bismuth. The electrolytic method has been put to practical use in the lead works of Trail, British Columbia. Direct production of lead from ores is usually not resorted to. With nickel the smelting process has been maintained; only for refining has electrolysis been used profitably. Electrolytic works for zinc have not been at all profitable, but it would seem that the electro-thermic process for zinc will become of greater importance.

Electricity as Motive Power for 1100-Ton Cargo-Boat.

By J. W. H. HAMILTON.

SEVERAL systems for the transportation of boats by means of electric power have been tried. For small launches, going short distances, the electric accumulator soon entered the field. For the towing of heavy canalboats the "electric mules," or locomotives, running on a track along the canal and taking the current from an overhead trolley wire, have been used in Europe for several years, and have also been tried in this country. The idea of carrying a complete electric generating plant on a ship, and using electric motors on the propeller shafts may be new to the engineers on this side of the Atlantic.

The high efficiency and small weight and bulk of modern oil engines has made them very desirable as prime movers of ships. However, for many years their use has been limited to small motor boats, on account of the difficulty in making a good reversible and variable-speed oil engine. The various kinds of reverse gears, which are extensively used on small boats, are entirely impracticable on large ones, and it was therefore suggested to introduce electricity as transmitting power between the engines and the propeller shafts. Through this arrangement the simplest and most complete control of the boat is obtained. A cargo-boat built on this principle was completed last year, and has been in daily service for several months. The technical as well as the economical success of the system has already been proved, and a second boat of similar design has been ordered. A few data may be of interest to electrical engineers, and will probably make shipbuilders of the old stock ask themselves whether a revolution in the maritime transportation will not soon be at hand.

The boat, which is named "Vandal," was built for Nobel Brothers, of St. Petersburg, the big Russian company, for the transportation

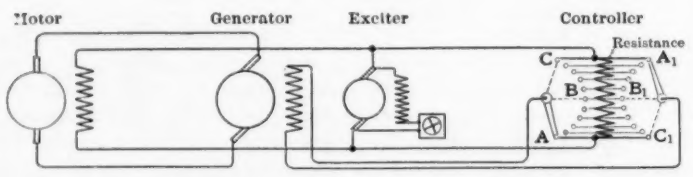


FIG. 1.—MOTOR-CONTROL CIRCUITS.

of oil from Rebinsk on the Volga to St. Petersburg, a distance of 700 miles. The hull of the ship, which is made of steel, was built in Nischni Novgorod. The overall length is 245 ft., beam 32 ft., and at full load the draught is 6 ft., and the displacement about 1,100 tons. As the river in many places is very shallow, the bottom of the ship has been made flat. Three propellers are used, and three units of oil engines of the Diesel type, direct connected to the electric generators. The generating plant is located amidship, and the three motors are in the stern, thus reducing the propeller shafts to minimum length. Oil tanks for the engines are located in the bow and stern; their aggregate capacity is about 12,000 gallons. The amount of oil consumed on one round trip is about 3,600 gallons.

Each of the three Diesel motors develops normally 120 effective horse-power. They are vertical, three-cylinder, single acting, four-cycle engines, built by the Diesel Motor Company, of Stockholm, Sweden. These motors run almost as smoothly as steam engines, the combustion in the cylinders being rather slow. Another advantage of the Diesel motor is the self-ignition of the gases, caused by their high compression. All trouble with spark apparatus is thus eliminated. The Swedish Diesel motor has reached a very high grade of perfection. The complete combustion of the gases, combined with the practical arrangement of these motors, make them more efficient than any other engines in the market. Careful tests on large machines in actual service have shown that at full load 35 per cent of the energy in the fuel is turned into useful work. Compared to the very best steam engines, for which the corresponding figure will be 13 per cent, the result is remarkable.

The three electric generators are connected by leather couplings to the Diesel motors. Direct-current machines are used. Each generator feeds its own motor, but can, if necessary, be connected to any one of the three propeller motors. The exciters are mounted on the generator shafts and supply current not only for the generator and motor fields, but also for the lighting of the ship, searchlights, steering-gear, pumps, hoists, etc. Controllers for operating the propeller motors are mounted on the bridge, so that the man in charge of the ship can run it by turning the handles of the controllers. The whole electrical equipment has been furnished by the Allmänna Svenska Electriska Aktie Bolaget," of Westeras, Sweden (The General Electric Company of Sweden).

Some details of the controlling apparatus have been worked out very ingeniously and possess some novel features. The principle of the motor control is shown in the diagram (Fig. 1). As the exciter is used for various purposes, its voltage is held constant. A

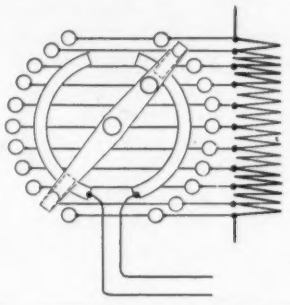


FIG. 2.—CIRCUITS OF CONTROLLER ARM.

resistance is shunted across its brushes. This resistance, which has several taps, is connected to two sets of contact buttons on the controller. The generator field is connected to the two contact arms. Suppose that the motor is running and that the controller arms are in position, $A\ A_1$. The generator will then receive full field current. The motor always gets its field current directly from the exciter. By moving the contact arms towards $B\ B_1$, the generator voltage will drop, and when the arms come opposite to each other there will be no excitation, and the motor will stop. If the arms are turned towards $C\ C_1$, the field current of the generator will flow in opposite direction, thus reversing the armature current and therefore also the rotation of the motor. By being able to stop, start and reverse the motor by changing merely the field current of the generator, a very safe and effective control of the motor is obtained. The speed can be varied between 30 and 300 revolutions per minute, and the commutation is sparkless at all speeds. The efficiency of this system decreases very little at low speeds, as the copper and iron losses in the generator are very small at low field excitation.

In mechanical construction the two controller arms are combined in one, as shown in Fig. 2. The curved sectors are connected to the generator field, and the contact buttons are connected directly to the resistance.

Obviously, the life of this controller, as well as that of the rest

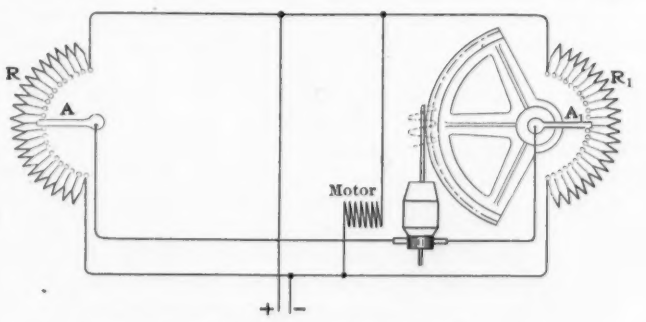


FIG. 3.—DIAGRAM OF STEERING APPARATUS.

of the motor and generator equipment, will be very long, and the cost of maintenance will be insignificant. There is no main current to break and make, no arcing contactors to replace, and there will be no severe stress put on the insulation. These controllers enable a man on the bridge to change the speed of the motors from full positive to full negative value in twelve seconds. The whole system gives entire satisfaction. On ordinary boats the failure of the engineer promptly to execute the orders, given through some kind of signal system from the bridge, sometimes causes serious accidents. This source of trouble is entirely eliminated by controlling the motors direct from the bridge and not through a second person.

The great amount of power required for steering a large ship necessitates the use of motors for operating the steering gear.

Generally steam engines are used for this purpose, and they work satisfactorily. However, the whole mechanism is rather complicated and expensive, and requires a great deal of attention. Several kinds of electric steering apparatus have been tried successfully. The system adopted on the "Vandal" works very satisfactorily, and has the advantage of great simplicity. Fig. 3 shows a diagram of the arrangement. R is a resistance with a movable contact arm, A, operated from the bridge of the boat; R_1 is a resistance with a contact arm, A_1 connected directly to the rudder post. A shunt motor, the armature of which is connected to A and A_1, operates the rudder through a worm gear. The motor field coils and the two resistances, R and R_1, are connected in multiple to the exciter.

As to the first cost of the machinery, the three Diesel motors and the whole electrical equipment, including also lighting, hoists, steering apparatus, pumps, etc., cost $30,000. Steam engine builders had offered to equip the boat with two compound steam engines of the same capacity as the three Diesel motors at a cost of $21,500. In order to make the electrical apparatus pay, a saving of somewhat over $1,000 per year must be effected. Experience has shown that, counting only the reduction in the fuel bill, this amount of money will be saved in two months, when the boat is kept running practically all the time. A few figures on the fuel economy will be of interest.

The thermal units of crude petroleum are about 11,000 CK. (calories per kilogram), and of coal about 8,000 CK. As previously has been stated, this type of Diesel motors will turn 35 per cent of the 11,000 CK. of the oil into effective work, whereas a steam engine of the very best type will take care of only 13 per cent of the 8,000 CK. of the coal. It is apparent, therefore, that one ton of oil will do just as much effective work as 3.7 tons of coal. The prices of oil and coal vary a great deal in different places. In St. Petersburg a ton of coal costs about $4.80. The price of petroleum averages $9 per ton. The coal will cost twice as much as the oil, and allowing 20 per cent for the losses in the electrical machinery, the saving for fuel will be considerable. By reducing the weight of the fuel over 60 per cent., the carrying capacity of the ship will be correspondingly increased. Of course, the electrical machines will entail some extra dead weight, but hardly as much as the water-filled boilers in a steamboat. Further, a great deal of piping and auxiliary machinery, necessary for a steamboat, is done away with. Everything considered, it was estimated that the cargo capacity of the "Vandal" gained 10 per cent. by using oil engines and electrical-power transmission instead of steam engines.

The second boat, named Samarat, which is now being built, is of somewhat different design. Only two sets of Diesel motors are to be used, each developing 180 effective horse-power. All machines will be located in the stern of the boat. No extra motor attendants will then be required. The engine and propeller shafts will be supplied with clutches, so that when the boat is to run a long distance without stopping, the engines will be connected directly to the propeller shafts. The first cost of "Samarat" will be less than that of "Vandal," as only two sets of machines and one machine room will be used. The running expenses of this boat will also be reduced, as the electric transmission will be cut out for long runs, and the number of dynamo tenders will be less.

Considering these facts, the Samarat will be a highly economical boat, and it will probably compare favorably with steamboats even in places where the price of oil is higher than in Russia. Obviously, the relative price of oil and of coal is the most dominant factor in deciding which type of boat will be the most economical for a certain locality.

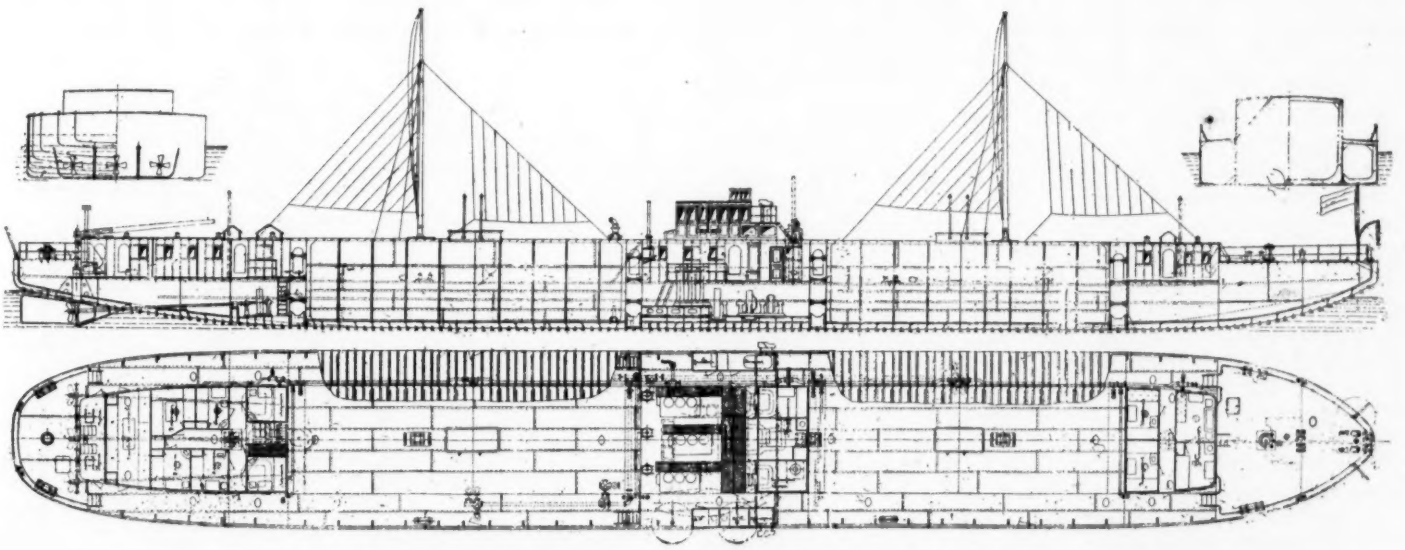


FIG. 4.—ELEVATION AND PLAN OF MOTOR-DRIVEN CARGO BOAT.

The Electric Plant at Medellin, Colombia, S.A.

BY C. H. HINES.

IN a previous article in this paper, entitled "The Installation of Electrical Machinery in the Tropics," was given a short sketch of the very many difficulties that exist in this class of work. The present article deals with a description of a typical plant of this kind, but one that presents a maximum of difficult work. It is hoped that the article will serve also to call attention of Americans to the richness and opportunities offered by a land lying almost at their feet.

Medellin is the principal city of the Department of Antioquia, which in turn is the richest and most important department of Colombia. The city is situated in a beautiful plateau, about ten miles wide and thirty long, at an altitude of nearly 5,000 ft. above sea level, and is surrounded on all sides by lofty mountains, which furnish an almost inexhaustible supply of water power.

The city itself, with a population of over 80,000, has paved streets, sewers, water in the houses, a brewery, an ice plant and there is being erected a large factory for the weaving of cotton, which it is proposed to grow on a large scale. The great disadvantage under which it at present labors is its isolation. It is over 800 miles from the nearest seaport, 150 miles from the Magdalena River, and all freight must be transported over 90 miles by mules or oxen, so that machinery, either from the States or Europe, must first be landed at Savanilla, transferred from there to Baranquilla over a short and bad railroad, thence loaded on a river steamer, and carried a distance of 600 miles up the Magdalena River, again transferred to another railroad 49 km. long, and thence by mules or oxen 90 miles to its destination over roads of the nature of which no resident of the States can form any idea.

The roads have in some places grades of almost 45°, and bulky machinery must be dragged up the slopes by oxen and lowered down them by ropes fastened to trees. In the rainy season it frequently takes months on the road. There has just reached this place a shaft which has been nine months in transit, a distance of 90 miles. In addition to the delay, the added cost of freight is enormous. For example, a casting for the brewery here, costing $50 in gold originally, cost over $100 for freight from Caracoli.

Under such conditions the task of installing the plant here was stupendous and most costly.

The plant consists of four 50-kw General Electric monocyclic generators, wound for 2,300 volts, and four 50-light Thomson-Houston arc generators, all driven from a common shaft by a 600-hp Pelton water wheel taking water from a penstock 400 meters long with a head of 500 ft. These machines furnish power to about 3,000 incandescent lamps and 160 arc lamps, and carry in addition a day load of about twenty induction motors, ranging from 1 to 10 hp, which furnish power to the coffee-cleaning machinery in the "bodegas." The switchboard is of the skeleton wood type with General Electric station instruments, and presents no unusual features.

The power house is situated about a mile and a half from town, at the foot of a mountain. It is a low one-story adobe structure, but compact, light and airy. The prices charged for light are very reasonable, being about twenty cents per kw-hour for the incandescent lamps and a flat rate of $90 per year per arc lamp.

The plant was erected by an "engineer(?)" from the States and had been in operation, although never giving satisfaction, for nearly seven years. On inspecting the plant it was found that the incandescent machines, although compound-wound, had been erected and operated for all that period without either synchronizers or equalizers, and although three of the machines ran counter clockwise and one clockwise, the connections on the clockwise machine had never been changed. This bears out the statement in the previous article "that the selection of an engineer for these countries is generally on a par with the selection of the machinery," and readily explains why the plant had never given satisfaction. Another equally strange fact is that the arc machines, although frightfully grounded, have in seven years never burned out a coil.

The wiring of the town beggars description and would drive the members of the Board of Fire Underwriters insane. Wires are run over eaves, tiles and trees in any old way and plastered in walls without any protection whatever. A favorite method of fastening them is to bend a nail over the wire. Flexible cord is run outside buildings exposed to the weather, and fastened to the wood with iron staples. It is needless to say that the system is *slightly grounded.*

Another novel feature of the situation here is the fact that the demand for light is so greatly in excess of the supply that original subscribers sell part of their installations at prices ranging as high as $50 gold per light. In other words, a man possessing an installation of 20 lamps will sell the privilege of using ten of them to his less fortunate brother for the modest sum of $500. It is the intention of the company at an early date to utilize a part of the water power at the new cotton mills, now being built about twelve miles from here, to reinforce their present plant by a high-tension transmission system, and also to install an electric tram in the city itself.

The immediate need of the country is railroads. At the present the only one in the department is the one previously mentioned, which is poorly built, and worse managed, as it is owned by the government. Although only 49 km. in length, its cost runs into the millions, while a ride over it is an experience, *if survived,* not to be forgotten. Although the engineering features presented by a railroad from the river here are great, they are by no means insurmountable, and, with the abundant and constant sources of water supply, such a road could be operated electrically over its entire length, while in the valley of Medellin itself a road of about thirty miles long, running the entire length of the valley could be easily and cheaply installed. As the entire valley is dotted with small towns, and coffee "fincas" the interurban traffic, in addition to the sale of light in the small towns, would net a handsome profit, while twenty miles would be at once cut off of the mule haul, thereby lessening the delays, and cheapening and facilitating traffic.

In addition to an immense agricultural district, capable of raising anything and yielding crops perennially, the country is literally full of gold, both quartz and placer mines. Even in the stream that supplies the electric plant, gold can be washed out in "batteaus." At present the working of the mines is being carried on in the most primitive manner, but with proper facilities for the transportation of improved machinery the record of the Klondyke would be outclassed. Even under present conditions an investment of a comparatively small amount of capital yields handsome profits. Iron, platinum and emeralds, and, in fact, almost all minerals, are found here, although gold is the most abundant.

Labor is plentiful, fair and cheap, the average wages paid a "poon" or day laborer, being 30 cents per day. The people as a class are far more intelligent than in most other parts of South America, as here almost all all of the masses can both read and write. As the country becomes developed, the many and plentiful water powers can be taken advantage of to equip and operate the mines and also to extend a network of interurban roads to all parts. Fuel is scarce, but Nature has provided abundant power, and all that is needed is capital. At present the available capital is exhausted, as the country is passing through the throes of a severe financial panic owing to the after effects of the late ruinous war, but there is no real necessity for such condition. Given but the opportunity, this country will be the richest on the continent.

The climate in the higher parts is perfect, being about the same as a mild June day the year around, while the fevers and illnesses of other tropical parts are unknown. Americans are not molested in any way, although they are not socially welcomed, as the people here feel, perhaps rightly, that they were imposed upon by their more powerful sister republic.

Americans lose much trade here at present through their wilful neglect and disregard of the fact that packages must be light and strong where such high rates prevail. Cases are sent here that are heavier than their contents. With a duty of $1.50 per kilo, plus the enormous freights, this is a serious objection. The Germans and French make no such error. The electrical firm that would make a specialty of sectionalizing its apparatus to reasonable weights would reap a rich reward.

Measuring Angular Velocity of Engines.

BY PROF. F. W. SPRINGER.

THE following method will be found superior, in many respects, to the well-known tuning fork method for measuring the variations in speed during the different parts of a revolution, or cycle, of an engine. The method affords an exact determination of the distance traveled in certain chosen intervals of time by the periphery of the fly-wheel of the engine, and, therefore, necessitates the use of a mechanism for denoting the distance and for gauging the time.

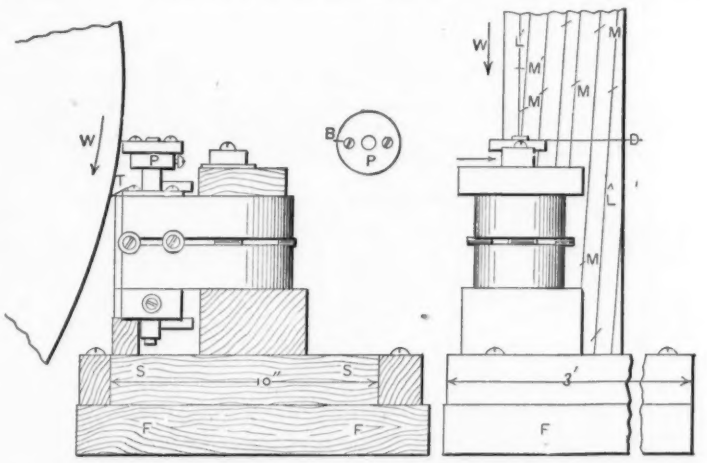


FIG. 1.—SIDE AND END VIEWS OF MAGNETO MOTOR AND MOUNTINGS.

The essential apparatus consists of a miniature motor which may be run at a constant speed of a sufficiently high value from any available source of current. The motor should be placed with its shaft perpendicular to that of the main engine, as shown in Fig. 1. On the motor shaft should be fitted a small pulley, indicated as P, to which is joined a wiping bristle, B, for the purpose of marking off the distances traveled by the periphery of the fly-wheel during one revolution of the motor. The motor should be mounted on a slider, substantially as illustrated, with its edges parallel to the face of the pulley and arranged to move freely in the guides. A tracer of wire, shown as T in Fig. 1, serves for making a line, L_1, on the chalked surface of the pulley when it revolves. This line is of assistance in forming a more or less regular spiral upon which the distances corresponding to the angular velocities are marked off by the wiper on the shaft of the motor.

After the face of the pulley of the engine has been thoroughly rubbed with chalk and the auxiliary apparatus has been placed as indicated in the drawing, the armature of the motor should be con-

nected to a source of current of such a nature that it will make one mark on the face of the pulley for every six or eight inches of periphery of the fly-wheel of the engine. When the conditions are proper for a record, and the motor is running steadily at the desired speed, the slider, *S*, should be moved by hand at such a rate as to obtain as many spiral lines as possible across the face of the pulley without confusing the cross marks, *M*, made for each revolution of the motor. The combinations of the spiral line and the cross marks form the record of the speed variations of the engine.

When the engine is stationary, a zero point with reference to the position of the fly-wheel may be found by setting the crank accurately on the dead center and moving the slider so that the wire, *B*, will make a mark, *D*, across the face of the pulley. The distances be-

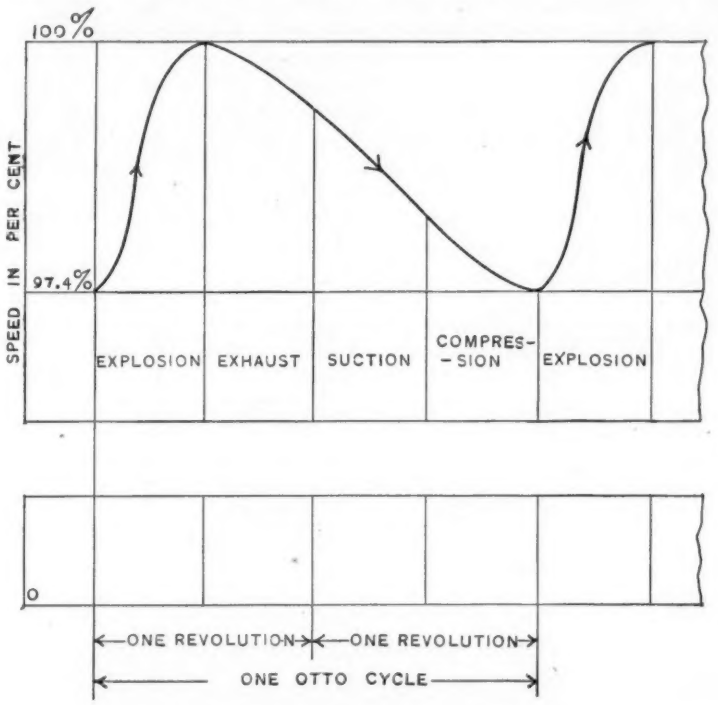


FIG. 2.—SPEED CURVE OF GAS ENGINES.

tween the consecutive intersections on the spiral line may conveniently be plotted as ordinates on cross-section paper, with abscissæ corresponding to the number of spaces on the spiral line. The ordinates evidently correspond to the different velocities of the fly-wheel at different times, and from these ordinates may be calculated the percentage variation in speed.

Messrs. Ryan and Kochendorfer, senior electrical engineers at the University of Minnesota, have recently applied the above method in tests on a number of gas engines especially constructed for driving dynamos. The curve shown in Fig. 2 was taken by them during a test on a direct-connected unit, consisting of a four-cycle, single-cylinder gas engine and a 125-volt, direct-current generator.

Gas Engine Ignition.

In a recent lecture before an English automobile club, Sir Oliver Lodge brought forward a gas-engine ignition system of his invention. He said that electric ignition might be regarded as almost a natural method of setting up combustion, because combustion, after all, was only electrical action. The force of chemical activity was electrical attraction at close quarters—an electric attraction between molecules. The lecturer introduced his own improved method of ignition, which differs from the present high tension system by coil, in that instead of the high-tension current from the coil being taken direct to the plugs it is taken to Leyden jars, and the tertiary current from the outer coats alone is conducted to the plugs. The Leyden jar or condenser acts in a way analogous to that of a spring and stores up the current gradually, throwing it out again with violence. As a result of this system, plugs were shown sparking in oil and in water, and generally reversing the ideas which at present prevail as to their treatment. It was suggested that in large gas engines the Lodge system would be found extremely valuable, as well as in launch work, where the installation of high-tension circuits is exceedingly difficult.

Single Wattmeter on Edison Three-Wire System.

By L. A. Freudenberger.

In an Edison direct-current three-wire system of electrical distribution, a single recording wattmeter is usually employed to read the total kilowatt-hours. Of the two series field coils one is put in each of the two outside mains, and the armature is connected across one of the sides of the three-wire system, that is, from outside to neutral. It is also possible to connect the armature across the two outside mains.

There are thus three possible methods of connecting the armature of the recording wattmeter, as follows: Across the two outside mains, as in the accompanying figure, called "Method I"; across E', called "Method II," and across E'', called "Method III."

The different methods I, II and III will be examined as to their relative errors.

In practice the two e.m.f.'s, E' and E'', cannot be kept exactly equal at the different distribution points; also the currents on the outside wires cannot be kept equal; that is, the system beyond the wattmeter cannot be kept strictly balanced.

Let E'' be greater than E' by the amount e; that is, $E'' = E' + e$. When E' is greater than E'', e will be negative. The total power delivered to the lamps is

$$P = E' i' + E'' i'' \ldots\ldots\ldots\

Equation (5) gives the correct expression for the total power in a three-wire Edison system. Expressions for methods I, II and III will be deduced and compared with equation (5).

Let the armature circuit of one of the above wattmeters be connected across the two outside mains (Method I). This will require sufficient resistance to be added to the armature circuit, so that its total resistance is $2R$. Then the same current as before flows through the armature, and consequently the starting coil (if there is one) does not require adjustment. If the resistance of the armature is not changed (value $= R$), then the current through the armature is doubled, and consequently the readings of the meter will have to be divided by two to give the correct power. Correct adjustment of the starting coil would require its turns to be halved. The above assumes, of course, that the armature circuit is capable of carrying the increased current continuously.

Assuming that the resistance of the armature circuit is doubled, the expression for the total power is proportional to the sums of the two forces, F' and F'', acting on the armature; that is,

$$F' = \frac{k\,n}{2R}(E' + E'')\,i'$$

$$F'' = \frac{k\,n}{2R}(E' + E'')\,i''$$

$$P = \frac{k\,n}{2R}\{(E' + E'')(i' + i'')\} = \frac{k\,n}{2R}\{2E'(i' + i'') + e(i' + i'')\}$$

$$P = \frac{k\,n}{R}\left\{E'(i' + i'') + \frac{e}{2}(i' + i'')\right\} \quad \ldots\ldots\ldots\ldots (6)$$

Let one of the above wattmeters considered in (4) be connected with its armature across E'. (Res. of armature $= R$.)

Then $$F' = \frac{k\,n}{R}(E'\,i'),$$

$$F'' = \frac{k\,n}{R}(E'\,i'').$$

Or $$P = \frac{k\,n}{R}\{E'(i' + i'')\} \qquad (7)$$

Consider the same wattmeter with its armature across E''.

$$F' = \frac{k\,n}{R}(E''\,i'),$$

$$F'' = \frac{k\,n}{R}(E''\,i'').$$

Substituting $E'' = E' + e$,

then $$P = \frac{k\,n}{R}\{E'(i' + i'') + e(i' + i'')\}. \qquad (8)$$

Comparing equations (6), (7) and (8) with equation (5), we see that if e is zero, that is, $E' = E''$, all three methods of connection give correct indications of the power. From equation (6) it is seen that when $i' = i''$ (balanced loads) method I indicates the correct power. In method II the wattmeter indicates *too low* values by $e\,i''$, while method III indicates too high values by $e\,i''$.

In practice the difference between the methods of connecting the armature would be insignificant except in the measurement of comparatively large amounts of power. Also where comparatively large amounts of power were concerned the ratio of $\frac{i'}{i''}$ or of $\frac{i''}{i'}$ would never be greater than 3. Within this limit, for a given value of e, method II would *always* give indications too low, method III would *always* give indications *too high*, while method I would have errors considerably less than either methods II or III. Also the errors in method I would, to some extent, neutralize themselves, since when i'' is greater than i' the wattmeter reads too low, and when i'' is less than i' the wattmeter reads too high.

Electric Water Power in Great Barrington, Mass.

HOUSATONIC RIVER falls about 400 ft. between its source in Lake Pontoosuc and the Massachusetts and Connecticut State line, some 40 miles to the south. This rapid descent of the river between the rugged ranges of the Hoosac and the Toghconic Mountains forms many waterfalls that are utilized in a number of cases for electric lighting and manufacturing purposes. Such a development is that at Great Barrington, where the river drives the machinery at an electric station that was equipped in 1903.

Prior to April of that year electrical supply in Great Barrington had been carried out with power from the plant of the Monument Mills Company, some six miles up stream, since 1895. The local lighting station in Great Barrington before 1895 was driven by steam power, but it was then found that energy developed by water power could be purchased at a cost less than the steam station could be operated. In 1903 the lighting company at Great Barrington decided to install its own generating plant in a building that had been occupied as a woolen mill there on the river bank. The water power is obtained from a dam near by, and new concrete foundations have been built for the generating equipment beneath a part of the main floor.

As the head of water made available by the dam is not great, and hence the speed of the wheels is low, it was decided to drive the generators by belt connection with a main shaft, which operates at 357 r.p.m. To this shaft were connected three Holyoke turbine water wheels, each of 45 inches diameter. These turbines are regulated by Schenck governors. Belts from this shaft drive two 2,400-volt, 60-cycle, two-phase alternators, one of which is rated at 72 and the other at 150 kw. Each of these alternators operates at 1,000 r.p.m. and is belt-connected to its exciter.

The two alternators just named were not of sufficient capacity to operate the entire electric load at Great Barrington when they were installed, and it was the intention to add a third similar machine of 200 kw rating. Meantime energy for a part of the load continued to be transmitted from the plant at the Monument Mills that had previously supplied all of the current for the lighting system. Before this description of the plant appears it is probable that the new 200-kw generator will have been added, and that all of the power distributed by the system will be generated at the station in Great Barrington.

To provide for any possible lack of power at times of low water, an engine and boiler have been installed at the Great Barrington station. The boiler is of the Dillon make, tubular type, 6 ft. in diameter, 18 ft. long and rated at 150 hp with steam at 100 pounds gauge pressure. The engine is of the straight line type and is rated at 150 hp. By means of a belt connection, this engine can be made to drive the same shaft to which the water wheels are connected.

Connected to the lines of the Great Barrington company are between twenty and thirty enclosed arc lamps, upwards of 8,000 incandescent lamps and more than 200 hp of electric motors. In order to bring out fully the meaning of these figures, it should be stated that the village of Great Barrington consists mainly of a single street three miles in length, that it is largely a place of residence and a summer resort, and that its population is about 6,000 persons. Great elm trees line the main and side streets of this village, so that it is difficult to light the streets effectively by means of arc lamps, and all street lighting is done with 32-cp series incandescent lamps operated with current from the 2,400-volt alternators. There is little demand for arc lighting and the few lamps of this type in use are all connected to the 110-volt incandescent circuits. Incandescent lighting in stores and houses is done as far as practicable by means of two-wire or three-wire secondary mains at about 110 or 220 volts, and fed through two or more rather large transformers connected to the 2,400-volt lines. Some of these secondary mains are 500 to 600 ft. in length.

Most interesting of the loads on this little system is that of electric motors, all of which are operated with the two-phase alternating current, and with one exception are of the induction type. Thirteen of these motors have a combined rating of 247 hp, giving the large average of 19 hp per motor. A 10-hp motor is used in a lumber yard, a 30-hp motor drives the water supply pumps for the town and seven motors aggregating 183 hp operate the machinery at the factory of the Stanley Instrument Company. Of the motors at this factory the largest is of the synchronous type and has a capacity of 100 hp.

Comparatively low rates for current are, of course, the direct cause of these rather large lighting and power loads in so small a town, but behind these rates is the utilization of water power that makes them practicable. For commercial incandescent lighting, including that in residences, the maximum rate subject to discounts is 15 cents per kw-hour, and for motors the rate is much lower.

Back in 1894, before the Great Barrington system began to use water power, the total connected load comprised 33 arc lamps, 1,020 incandescent lamps and not a single electric motor. For the year ending June 30, 1894, the operating expenses of the Great Barrington company, with its steam-driven station and the connected load just stated, amounted to $6,376.38, and the gross income from operation was only $7,741.67. For the year ending at June 30, 1903, with about the same number of arc lamps as in 1894, with an addition of 7,000 incandescent lamps, and with 247 hp in capacity of connected motors, the entire expense of operation with water power using steam as an auxiliary was only $17,450.54, and the income from the sale of light and power was $26,343.55. To operate the small load of the earlier year, 655 tons of coal were burned, and for all of the steam necessary with water power to carry the much greater load of 1903 the consumption of coal was only 79 tons.

For some of the above facts we are indebted to Mr. H. Clyde Parish, superintendent of the Great Barrington company.

New American System of Wireless Telegraphy.

By James Foster King.

In your issue of January 21 appeared an article by Mr. A. Frederick Collins, entitled "A New American System of Wireless Telegraphy." While quite satisfactorily describing my system, it contains some errors relating to the transmitting formula. I, therefore, beg to give below a fuller statement of the formula.

It is assumed as a working hypothesis that

I. The initial exciting current, I, developed by the exciter, G, is constant for variable loads.

II. The impressed pressure, V, forcing this constant current through a circuit of variable resistance, depending on the relation

$$Vt = I\left[R + \frac{D\rho}{d\rho}\right] \quad \text{where } d \propto t \qquad \ldots\ldots(1)$$

must vary in accordance with an increasing arc resistance ($d\rho$) introduced into the previously closed exciting circuit as the movable contact, l, separates from the earthed contact, e.

R = constant resistance of exciting circuit when d is zero.

ρ = resistance constant for arc of unit length.

d = intermediate length of arc at any particular instant, t.

D = maximum length of arc.

III. The time rate of extinction of this arc, depending on the amounts of energy transferred through it in unit time, the amount and specific heat radiability of the free electrode vapor, and its inductance, must always be much shorter than a quarter period, $\frac{T}{4}$, of the closed circuit oscillator, so that it may be considered comparatively instantaneous.

IV. The self-inductance due to the exciter, G, is negligible, and practically all the inductance of the entire exciting circuit is due to the inductor, F.

The effective or total inductance value, L, of this inductor is proportional to the square of the number of closed current elements linked with the magnetic flux produced in the soft iron core, i, and may be very large for comparatively small constant exciting currents, if the magnetic permeability of the iron composing this core is great.

High effective inductance values are obtained where the iron composing this core has great permeability for the magnetizing force due to the exciting current employed, and when the flux density approaches saturation.

Any sudden variation in the exciting current caused by a partial or total extinction of the arc connecting the ruptured ends, l and e, produces a self-induced pressure wave, which, in this particular instance, traverses the exciting circuit in the same direction as the initial exciting energy.

The self-induced pressure wave will have an infinitely large value if the current, I, can be instantaneously reduced to zero and a correspondingly lower value as the time in which this current is reduced becomes appreciably long.

Variations in current traversing the arc will occur only when a path of better conductivity is formed between the separated contacts, l and e, than the previously existing arc. This becomes possible when these ruptured ends complete a circuit through a branch circuit at a time when the arc has reached a maximum length and resistance greater than the impedance Z of this branch.

This branch circuit, comprising the condenser, C, and inductance portion of the closed circuit oscillator, becomes intimately connected as an integral part of the exciting circuit as the movable contact, l, in traversing the gap between e and a comes in contact with a.

In transmitting, the movable contact, l, will come into engagement with the contact, a, and the exciting energy will be diverted from the arc existing between the lower surface of l and e, and will now charge the previously uncharged condenser as a series arrangement of circuits.

As the impedance offered to a charging current by a previously uncharged condenser is initially inappreciable, it is apparent that the impedance factor $\left[\frac{1}{2\pi n C_1}\right]$ of the condenser, C, need not enter into the equation expressing the actual impedance offered to the charging current.

$$Z = \sqrt{R_1^2 + 2\pi n L_1^2} \qquad \ldots\ldots(2)$$

and where $D\rho > Z$ it becomes evident that this arc will die out at its own natural period of extinction, III, and the exciting current now charging condenser, C, will vary (die out) in the quarter period $\frac{T}{4}$,

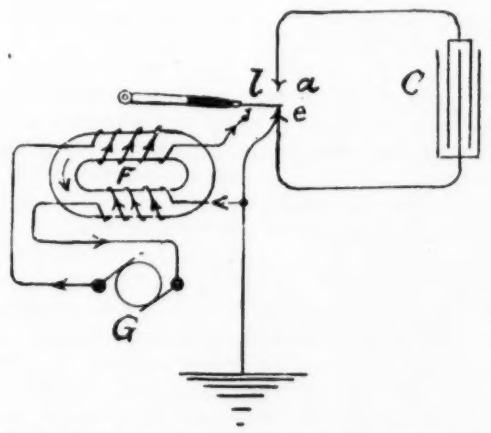


DIAGRAM OF KING WIRELESS TELEGRAPH SYSTEM.

as a wave, natural to this oscillator.

The self-induced pressure wave will have a maximum value equal to

$$V'' = 2\pi n L \qquad \ldots\ldots(3)$$

at the beginning of the charge and a minimum positive value at the beginning of discharge equal to

$$V' = 2\pi n L - \left[\frac{1}{2\pi n C_1}\right] \qquad \ldots\ldots(4)$$

The inductor impedance at the oscillator frequency, n, prevents the high pressure discharge of the condenser, C, from traversing and dangerously overheating the exciter windings. A disruptive discharge will, therefore, be forced across the discontinuity left in the oscillator circuit, thus allowing a periodical equalization of the constrained energies stored in this circuit.

The discharge or discharges are oscillatory in character if the oscillator circuit resistance, including that due to the spark-gap, satisfies the following equation:

$$(D\rho + R_1)^2 < \frac{4L}{C} \qquad \ldots\ldots(5)$$

The frequency, n, of this closed circuit oscillator may be determined by $n = \frac{1}{T}$, where the natural period of oscillation

$$T = \frac{2\pi}{\sqrt{\frac{1}{L_1 C_1} - \frac{(Dp + R_1)^2}{L_1^2}}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (6)$$

if the constants, L_1, C_1, R_1, and Dp, which represents the inductance included within the closed circuit oscillator, the capacity of the condenser, the resistance of conductors included within the oscillator and the spark-gap resistance, are known.

In this I have considered only the method of generating a train of electrical oscillations in a closed circuit oscillator, from the initial to the final form assumed by the exciting energy, and my purpose in attacking this problem has been to correct a false impression that may have been previously gathered that these distinctive reactions are too abstruse or obscure to be readily comprehended and explained by people conversant with electrical art.

Central Station Management.

BY GEORGE S. CARSON.

THE recent remarkable growth of central electric lighting stations can be attributed largely to the extension of power supply to the many small industries, extending over a large territory, which are operated through the medium of the high-voltage alternating current. These new conditions have complicated the question of business management and have led to new methods in the matters of distribution and sale of electricity.

More responsibility is placed on the central stations on account of supplying this power, upon which many workmen are dependent, and interruption of the service meaning a serious loss to the user. It is, therefore, important that the station is properly equipped for good, continuous operation, not only to give good service, but to do so economically.

Managers often have much to contend with to operate at a profit under existing circumstances and must be always alert to keep down expenses and save wastage. Starting in the boiler room, the boiler equipment should be large enough to carry the load without too much crowding and designed to use the lowest grade of coal. The drafts should be strong enough to burn this lowest grade coal, as it has been determined by test that the cheapest coal to burn is the cheapest you can buy.

Bituminous slack coal at $1.45 per ton of 2,000 pounds with a stack draft of .25 in. of water will evaporate 1,000 pounds of water at 212° at a cost of 15 cents, while the cost in using the same kind of bituminous lump coal costing $2.90 per ton is 24 cents per 1,000 pounds of water at 212° with the same draft and under the same boilers. This shows conclusively that it costs 60 per cent. more to use lump coal than slack where conditions and draft are sufficient to burn the slack coal. If the draft is not sufficient to burn this coal, then it is best to put up a steel stack of ample size. Here is one of the places where it is important to spend cents and save dollars.

Temperature of boiler feed water and regular steam pressure are important factors. Recording gauges on both feed water and steam will add largely to the profit side of the business. Workmen doing routine work without some check become careless, while if a record of temperature of boiler feed water and steam pressure be kept they will attend to business or lose their positions.

The engine is another source of losses and can spend money about as fast as any part of the equipment. The central station man who is one of the unfortunate ones having an engine using thirty-five pounds instead of twenty pounds of steam per indicated horse-power, can only find relief in keeping the valves and piston rings in good condition until such time as the company can afford to get an engine of high efficiency and of such construction that it will maintain its efficiency throughout its life.

The central stations have been used too much as experimental plants for the manufacture of the various types of electrical and power machinery, and it behooves the managers to be cautious in adopting any new appliance until after it has been tested several years in actual use and has demonstrated its durability and efficiency. If this rule is observed, the manager will steer clear of much unnecessary expense and trouble.

Taking up the station instruments, it is advisable to give them tests for accuracy at regular periods to insure that the current is sent out at proper voltage, and that all recording and measuring instruments are correct and can be relied upon as a check on customers' meters to ascertain current lost and unaccounted for. When we consider that one-fourth of all alternating current made and measured at the switchboard is "lost and unaccounted for" even under first-class working conditions, it will be seen that one of the most important questions of economy in central station management is to run down and stop this loss of current, which is all the greater because it is the finished product and has charged against it all station costs.

Experience has proven that most of the excess losses of current occur in antiquated small transformers and old-style meters. The finances of some companies may not permit of an entire change of meters and transformers at one time, but it will admit of a thorough testing of such apparatus. This should be done at the station or office of the company and not on the customer's premises, for the reason that it will cost less in the end to take meters down and test them where it can be done in a more thorough and accurate manner. Meters that cannot by repair be made accurate should be discarded, as it would be a reckless waste to have meters in use which are known to be slow. It is well to be careful in installing meters to use one adapted for the average current it is to measure, and not use a large meter on a small load, a certain amount of which will then not be registered.

When it comes to the transformer proposition, the small transformers can be discarded gradually and large transformers with longer secondaries installed. This will give better service and make a saving of current, but nothing in comparison to the amount which can be saved by correct meters. Many stations are not financially situated to make radical changes, but there should be none that cannot make gradual changes in equipment, which will give their patrons better service and increase their net earnings to a considerable extent. By doing a little each year and keeping at it in a systematic manner, the results will be good and gratifying.

If a syndicate is contemplating purchasing a plant, the first question asked is, What are your gross earnings? They do not ask for your net earnings, and, I believe, care little, because their knowledge and experience enable them to judge on what percentage of earnings the plant can be operated and how much net earnings they can figure on making. Often stations are purchased which have proven a failure and turned into a profitable investment just because knowledge and experience enabled great savings to be made in operating expenses. When the equipment and other conditions are not favorable for the proper economy—and in most cases they are not—then a modern equipment is installed, the lines are all thoroughly overhauled and transformers and meters tested and inspected and what was formerly a poor investment is transformed into a profitable one. I believe the whole matter depends first upon knowing what can be done and is being done in the best-managed and equipped stations, and then by a system of records kept by recording instruments above referred to, to check just what current is lost each month and what price is received for all current sold and what price is received for all current made at the switchboard. By this plan any electric lighting station can increase its net earnings to a very large degree and many unprofitable plants put on a paying basis.

Considering the consumer's side of the business, it has always appealed to me that selling current to all consumers on the same basis of cost is the proper method. This can be done by taking a fixed base rate per kw-hour for all current up to the maximum demand of each consumer, which maximum can be determined by the number and candle-power of lights wired up, or by a current demand meter that registers the maximum current used in any given period of time, on this maximum current charging the full base rate. For current used in excess of the maximum a much lower rate applies. This method of charge places all users of electricity on the same basis and it is, therefore, equitable to all. The consumer using light but one or two hours of each day will pay a higher rate per kw-hour than one who uses light longer, the higher charge being made to cover the cost of fixed charges on the plant and readiness to serve, which must be considered an important part of the cost of operation.

The item of minimum bill should not be overlooked and can be arranged in proportion to the maximum demand of the consumer. The same rule can be applied to selling current for motor use by charging a certain rate for the maximum current used on a basis of two hours each day, with a much lower rate for all current used in excess of that amount, and with a monthly minimum bill for each horse-power of maximum demand in case the power is not used

during the month—this charge being made to cover fixed charges on that much of the station equipment as the motor uses at maximum; or if the motor is used during the day only, then the minimum charge can be divided between the power and lighting load.

It is desirable to secure a summer load which, in the small towns, can often be done by operating sand pumps, rock crushers and refrigerating machines. These can be given a special rate on account of not coming on the peak load in the winter months.

Where the voltage regulation is good, the Nernst lamps are proving successful on alternating current and are meeting the competition of the gas "arc" light with good results. The cost of maintenance of the Nernst is one-half cent per kw-hour on the 220-volt, two-glower and large lamps, which is about the same as the cost of incandescent lamp renewals.

There is another feature of the business which we all must consider, and that is, the public are not serving the companies, but the companies are the public. If every employe will bear this fact in mind and have a civil answer for questions and treat the consumers with the same consideration and respect which he himself would expect of others, a different feeling would be shown toward the corporation and better relations would exist between the company and its patrons. The matter of looking after complaints and giving them prompt attention and just consideration is no more than should be done, as there is nothing so aggravating as to be turned down with a short, uncivil answer by some self-important clerk when a case is entitled to attention. These are, I believe, just as important matters in the management of the business as the economies of operation, and will have a bearing on the progress and growth of the business which has required much money and hard work to establish.

Portable Equipment for Wireless Telegraphy.

ONE of the most promising fields for the application of wireless telegraphy is found in the communications between different sections of an army during war. For such a service it is essential that the necessary equipment be sufficiently light and compact to admit of transportation, and that it possess great durability to withstand the severe duties imposed upon it. The equipment described below, as developed by the Gesellschaft für Drahtlose Telegraphie, of Berlin, has been found entirely adequate for transmission over a distance of about 25 km. across flat country, while the total weight when arranged for transportation is only from 200 to 300 kg.

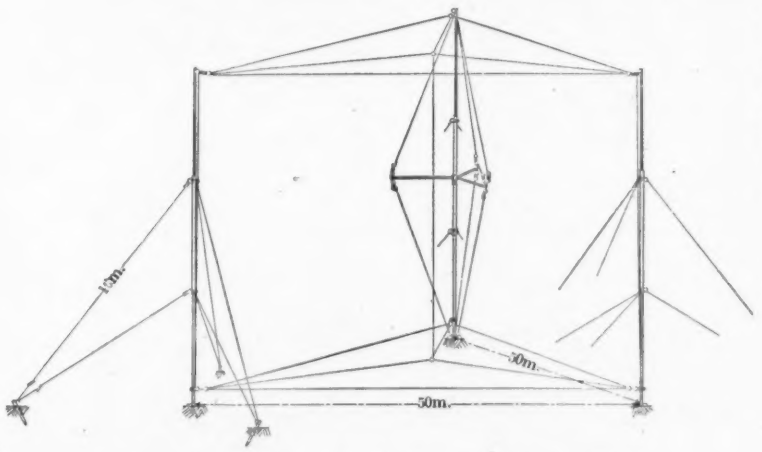


FIG. 1.—ASSEMBLY OF MASTS FOR EACH STATION.

The novel features of the apparatus reside in the use of telescopic steel tubes for the masts for holding the aerial wire, and in the employment of a man-driven generator.

At each station are used three masts, each being 10 meters in length when extended and 3.8 meters long when telescoped (see Fig. 1). To provide for sufficient stability, each mast is equipped with cast-iron plates and is supported by six steel cables connected with hooks fastened into the ground. In Fig. 1 can be seen the arrangement of the aerial net and counterpoise, and also the fittings of tension cables to prevent buckling of the masts. The weight of each mast, including its share of the various cables, is 20 kg. For the aerial net, as well as for the counterpoise, there is used a cable consisting of eight wires of tinned copper 4 mm. in diameter. The insulators are made of glass, which, on account of its lightness and durability, has given entire satisfaction.

Fig. 2 shows the portable generating equipment, which consists of a 100-watt, direct-current dynamo driven by belt from a specially-constructed aluminum wheel which receives its power through a chain from a sprocket wheel similar to that used on a bicycle. The

FIG. 2.—PORTABLE GENERATING EQUIPMENT.

speed reductions are such that a length of spark of 4 mm. is produced at the inductor by normal speed at the sprocket wheel. The weight of the dynamo equipment is about 30 kg. Instead of the dynamo just described, as a source of power there may be used a storage battery consisting of eight cells having a capacity of about 30 amp.-hours at a 5-hour discharge rate. The elements are enclosed in ebonite cases, which are placed in two wooden boxes. Each box, complete with cells, weighs 30 kg.

The transmitting apparatus is mounted within a wooden box measuring 540 x 230 x 320 mm. and provided with a carrying strap.

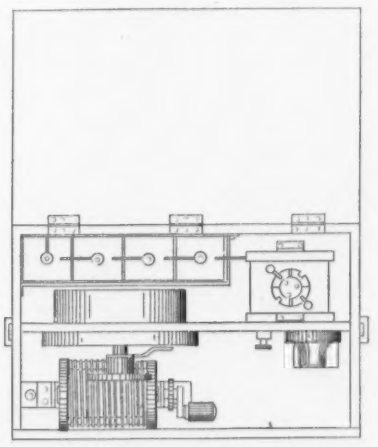


FIG. 3.—RECEIVING BOX OPEN.

The transmitter box, an interior view of which is given in Fig. 3, contains a Morse key, an inductor, a condenser, a spark-gap with electrodes of zinc, and an induction coil, which, with the Leyden jar condenser, is syntonized to a wave length of 400 mm. The transmitter weighs about 30 kg.

The receiving equipment weighs about 15 kg. It is enclosed in a box measuring 400 x 250 x 250 mm. and consists of four dry cells, a condenser of variable capacity, a double telephone and an electrolytic wave detector. The detector, which is of the Schloemilch type, needs no mechanical shaking and requires no special attention. The

disposition of the apparatus is such as to insure a high degree of freedom from atmospheric disturbances.

For transportation ten men are needed when a dynamo is used as

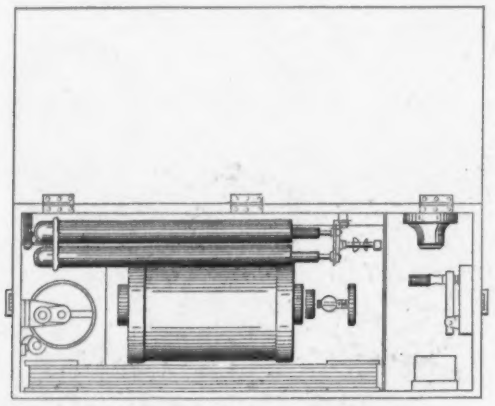


FIG. 4.—TRANSMITTER BOX OPEN.

the source of energy, while when a storage battery is employed eleven men will be needed. When so desired three horses can be used for transportation.

The Use of Small-Size Carbons in Enclosed Arc Lamps.*

The object of this is to present to you results obtained and observations made on a series of tests on the enclosed arc lamp for the purpose of determining whether or not its efficiency could not be improved without too great a sacrifice in maintenance cost.

To determine the variation of candle-power by varying the size of carbons, a lamp was taken with clear glass, closed bottom bulb. It being desirable that the test should represent the conditions which would be obtained in ordinary practice, the carbons used were selected from the regular stock of ½-in. American carbons. The lamp was equipped with its regular ½-in. carbon holders, and the different sizes of carbons tested were obtained by turning down the ½-in. carbon to the desired size, care being taken that no shoulder was left on the lower carbon which would shadow the arc. The length of the carbon turned down varied from 1½ to 2 in. Candle-power measurements were made by means of the Abady-Simmance flicker photometer, the light being reflected from both sides of the arc by means of two adjustable mirrors. The photometer was standardized by means of standard incandescent lamps.

The arc was allowed to burn for half an hour before candle-power measurements were made, and from ten to sixty readings were taken at each angle, depending upon the amount of fluctuation of the light. All measurements were made with a potential difference of 80 volts at the arc and with a current of 3.5 amp. Table No. 1 gives the results obtained on these tests and light distribution curves are shown in Fig. 3.

TABLE NO. 1.— VARIATION OF CANDLE POWER WITH SIZE OF CARBONS.
80 Volts—3.5 Amperes.

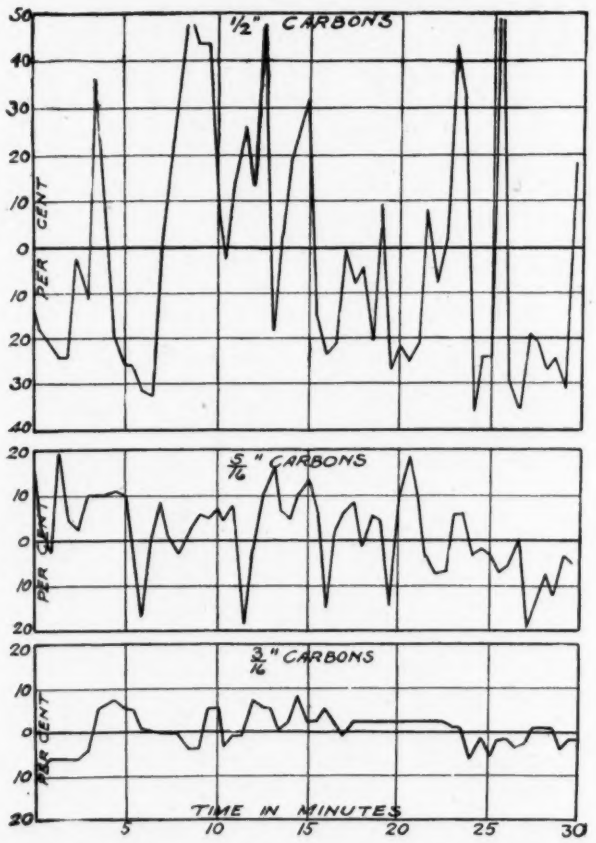
	Size of Carbons						
Angle	1-2 in.	7-16 in.	3-8 in.	5-16 in.	1-4 in.	3-16 in.	1-8 in.
30 deg.	77	97	77	121	65	140	155.5
15 deg.	51	64	71	95	95.3	159	190
0 deg.	86	99	73	99	96	165	229
15 deg.	149	151	177	185.5	275	249	322
30 deg.	291	292	299	310	306.5	401	431
45 deg.	196	322	351	394	378	485	554
60 deg.	182	212	240	323	343	484	555
75 deg.	50	105	116	144	208	387	498
90 deg.	50	90	25	25	37	56	66

It will be noted in table No. 1 that at the angle of 30° below the horizontal the increase in candle-power of the ¼-in. carbon is only 15 candle-power, or a gain of 5.16 per cent. At this angle the crater is always visible and is not shaded by the lower carbon. With the 3/16-in. carbon the increase is 110 candle-power, or a gain of 37.8 per cent. This sudden increase is probably due to the fact that the crater of the 3/16-in. carbon covers the entire end of the positive carbon, and the carbon is maintained at a high state of incandescence for some distance back from the tip.

The mere statement of increase in light obtained gives no appreciation of the quality of the light from the small carbon. When the crater covers the entire end it is evident that the wandering of the arc practically ceases and the light becomes very much more stable. To illustrate this point, sixty readings were taken at one-half-minute intervals on the 45° angle below the horizontal. To show the relative variation, Fig. 1 was plotted, in which the variation of candle-power is shown in per cent. above and below the normal. It should be borne in mind that these candle-power readings were taken with the light reflected from both sides of the arc. If the candle-power had been measured from one side only, the increase in the amount of fluctuation of light from the ½-in. carbon would have been increased in a much greater proportion than the increase in fluctuation in the smaller size carbons.

In order to confirm the increase in efficiency to be obtained by using 5/16-in. carbons instead of ½-in. carbons, two lamps were sent to the Electrical Testing Laboratories in New York, the following tests made and results obtained:

The carbons submited were of American make, two pairs being ½ in. in diameter and one pair 5/16 in. in diameter. These carbons were used in two similar enclosed arc lamps. Both lamps were adjusted for 3.5 amp. with 80 volts at the arc for the first test, and 5 amp. and 80 volts at the arc for the second test. All measurements were made when the current and voltage were at these values. The same opalescent inner globe was used in all tests, being cleaned



FIGS. 1 AND 2.—CURVES OF FLUCTUATIONS OF LUMINOUS INTENSITIES.

after each test. Measurements were made by a Matthews arc lamp photometer. The carbons were allowed to burn an hour before any measurements were taken. The results were as follows:

TABLE NO. 2.—DISTRIBUTION OF LUMINOUS INTENSITY.

	1-2-in. pencils. Avg. Amp.	1-2-in. pencils. Avg. Amp.	5-16-in. pencils. Avg. Amp.	1-2-in. pencils. Avg. Amp.
Angle	5.0	3.5	3.5	5.0
60 deg. above	84	37	62	121
45 deg. above	147	76	122	249
30 deg. above	194	125	143	301
15 deg. above	200	100	184	328
Horizontal	223	125	191	316
15 deg. below	312	177	259	433
30 deg. below	458	176	259	449
45 deg. below	414	174	261	498
60 deg. below	186	113	216	342
75 deg. below	116	52	148	181

TABLE NO. 3.— MEAN SPHERICAL CANDLE POWER.

Size. Carbons,	Line. Voltage,	Arc. Voltage,	Current. Amps.	M.S. C.P.	Watts.	Ter. watts. per M.S.C.P.	Arc watts per M.S.C.P.
1/2	120	80	3.5	123	420	3.41	2.27
5/16	120	80	3.5	188	420	2.23	1.49
1/2	120	80	5.0	238	600	2.52	1.68
5/16	120	80	5.0	330	600	1.82	1.21

* Abstract of paper read by Mr. Geo. N. Eastman before the Chicago Branch of the A. I. E. E., March 28, 1904.

TABLE NO. 4.—MEAN LOWER HEMISPHERICAL CANDLE POWER.

Size. Carbons,	Line. Voltage,	Arc. Voltage,	Current. Amps.	M.S. C.P.	Watts.	Ter. watts. per M.S.C.P.	Arc watts per M.S.C.P.
1/2	120	80	3.5	150	420	2.80	1.87
5/16	120	80	3.5	222	420	1.89	1.26
1/2	120	80	5.0	320	600	1.87	1.25
5/16	120	80	5.0	406	600	1.48	.99

It will be noted that the increase in luminous intensity of the 3.5-amp. lamp with 5/16-in. carbons over the ½-in. carbons is 52.8 per cent. The increase in candle-power of the 5-amp., 5/16-in. carbons over the ½-in. carbons is 38.2 per cent.

The principal objection which will be raised to the introduction of the smaller size carbons is the shorter life and the resultant increase in cost of trimming. The increased cost of carbons is such a small part of the total cost of maintenance that it need not be considered. The point in favor of the use of small carbons which has not been previously considered is the lack of decrease in light due to the carbon deposit on the inner globe.

In the tests just mentioned on the 3.5-amp. lamp the increase in candle-power due to the 5/16-in. carbons was 52.8 per cent. The inner globe was perfectly clean. Had the candle-power been measured at the end of the carbons' life the carbon deposit of the inner globe would have cut down the light of the ½-in, carbons approximately 32 per cent. and at the end of the life of the 5/16-in. carbons approximately 8 per cent., making the efficiency of the 5/16-in. carbons 104 per cent. greater than the ½-in. carbon at the end of its life, the average difference in candle-power being 73.7 per cent. throughout the life of the carbon.

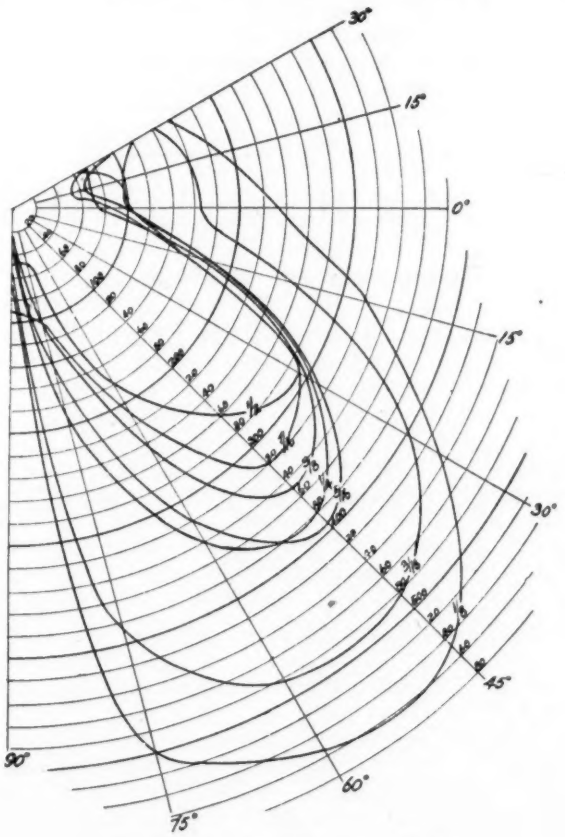


FIG. 3.—LIGHT DISTRIBUTION CURVES.

On account of the variation of carbon consumption due to the leakage of air into the enclosing globe, it was found very difficult to obtain tests giving uniform results in tests made for carbon consumption.

In tests with variable sizes of carbon it was found that, although the total grams consumed remained practically the same for all the sizes of carbon, the consumption of the lower carbon decreased while the upper carbon increased as the size of carbon diminished. It was noted that when burning the 3/16-in. carbon with 6 amp. and 80 volts at the arc, that a mushroom would be formed on the lower carbon and the consumption of the lower carbon ceased, the entire consumption then being obtained from the upper carbons. With 4 amp. and 80 volts no mushroom was obtained nor with the 3/16-in. carbon, but a mushroom was obtained on the ⅜-in. carbon. Apparently the mushroom formation is obtained with a current density at which the lower carbon ceases to be consumed. It would appear that the maximum efficiency of the enclosed arc lamp would be obtained when the lamp is operated with a maximum current which can be maintained without producing the mushroom formation. Under these conditions there would be practically no consumption of the lower carbon and the arc would remain in a fixed position in the globe.

Electrical Plowing in Italy.

The Società Elettrotecnica Italiana, of Turin, has taken up the manufacture of electrical machinery for agricultural purposes, and proposes to put out a full line of farm apparatus. The electric plowing system, the apparatus of which is illustrated herewith, is

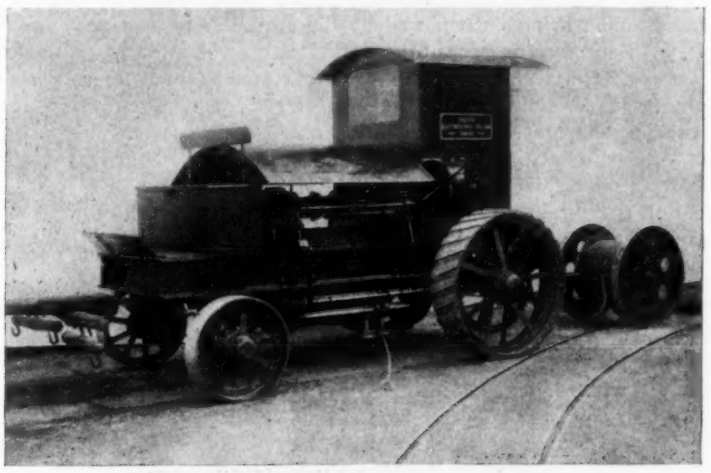


FIG. 1.—ELECTRIC PLOW WINCH.

a result of considerable studies made on electrical plowing in Italy and elsewhere. It consists essentially of two motor winches mounted on trucks, one being stationed on each side of the field to be plowed. The plow used is of the balanced Fowler type, similar to that used for steam plowing, and is hauled across the field in either direction by the winches by means of a steel cable. The winches are equipped with a 20-hp induction motor connected with the windlass by reduction gear. The plow will turn furrows from 10 to 24 in. deep. For change of speed the winch is equipped with interchangeable gears giving a plowing speed of 2½, 4, 5 and 7 ft. per second, these speeds being sufficient to meet the most variable conditions of work. An automatic device breaks the current when the plow is at the end of its travel. The truck is equipped with steel wheels and is operated by the motor which it carries. Each truck is equipped with a small switchboard carrying all of the necessary controlling

FIG. 2.—ELECTRIC PLOW IN OPERATION.

devices. A furrow 1,000 ft. long can be turned in eight minutes, and as the plow turns three furrows at a time an acre can be plowed in an hour and a half. The current is conveyed to each of the trucks by means of a flexible cable wound on a reel fitted with wheels. The windlass trucks can also be used for other farm work,

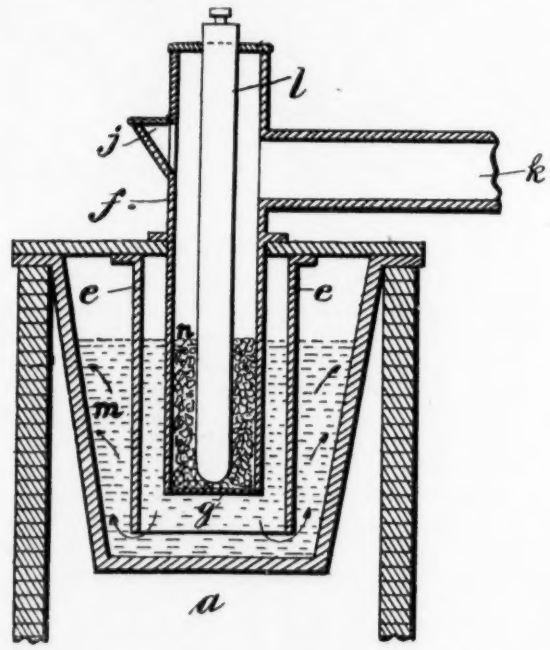
such as transporting harrows, etc., and can be employed for threshing, pumping, and, in fact, all farm purposes necessitating the use of considerable power.

Recent Electrochemical Developments.

ELECTROLYTIC PROCESSES.

The electrolysis of pure alumina—aluminum oxide—in the molten state requires such a high temperature that there results a prohibitive loss of aluminum by volatilization or dissipation by the resulting gaseous products. For this reason C. M. Hall, in his pioneer experiments, sought a suitable solvent for alumina and found it in the double fluoride of aluminum and sodium (cryolite). The working temperature of the bath, as now used at the plants of the Pittsburg Reduction Company, is 1,650° to 1,740° F., only the alumina being decomposed by the current. In a recent patent H. S. Blackmore proposes to use a solution of alumina in aluminum fluoride. He mixes two parts by weight of aluminum fluoride with one part of aluminum, melts the mixture and electrolyzes, the working temperature being about 1,800° F. He uses an alternating current and a direct current simultaneously, the former for the heating effect, the latter for electrolysis.

For the production of aluminum alloys the same inventor proposes a process which may be described by its application to the production of an aluminum-copper alloy. To a fused bath of lithium and calcium oxides he adds copper oxide with aluminum oxide and electrolyzes the bath.



PRODUCTION OF CARBON-TETRAFLUORIDE GAS.

The production of carbon-tetrafluoride gas (for the cheap manufacture of artificial alcohol, acetic acid, formaldehyde, etc.) is patented by J. A. Lyons and E. C. Broadwell. The apparatus is shown above. *a* is a crucible, the inner lining of which forms the cathode, *e* is a partition of graphite, *f* a vessel of non-conducting material, with an open-work bottom, *g*. The graphite rod, *l*, forms the anode. A foundation bath, *m*, of sodium and potassium fluoride is filled into the crucible and kept in a molten state, whereupon a quantity, *n*, of charcoal, lampblack, etc., is introduced through *j*. It surrounds the lower portion of the anode, *l*, and floats upon the bath, *m*.. Upon electrolysis, fluorine gas is set free at the anode; it combines with the carbonaceous material, *n*, to form carbon tetra-fluoride gas, which escapes through *k*. The reaction takes place at 1,000° C.

The same inventors have devised a process for the production of boron or metallic borides by the electrolysis of fused borates. The anode is a carbon rod with a surface small compared with that of the cathode, so that the carbon anode is kept intensely hot by the current. The boric anhydric anion being discharged at the incandescent anode is reduced chemically to boron, while carbon-monoxide gas is evolved. There is a partial partition provided between anode and cathode to prevent the boron from floating over to the cathode. To produce the boride of a metal the inventors propose to electrolyze the borate of the same metal with the partition removed, so that the boron reduced at the anode floats over to the metallic cathode deposit, and forms the boride.

An interesting modification of the mercury cathode cell for the electrolysis of sodium chloride is patented by Herbert Philipp. The difficulty with all mercury cathode cells is the effective removal of the sodium amalgam from contact with the salt solution at the proper time. The present inventor uses a mercury cathode in form of an uninterrupted shallow stream winding about a cylindrical built-up carbon anode, the speed being regulated and the volume of the flow of mercury gauged to suit the density of the electric current used.

For use in an electro-cyanide process for the recovery of gold, W. A. Hendryx patents mechanical details of construction of an agitating vat in which the pulverized ores and slimes are continuously and progressively agitated and aerated, and their values recovered by electrolytic deposition.

For "electrogalvanizing," i. e., plating iron with zinc, E. D. Kendall patents the use of an aqueous solution containing zinc sulphoglycerate as electrolyte.

Mechanical details of electroplating apparatus are described in a patent of H. Fleischer and C. H. Fleischer and in a patent of L. Potthoff.

LETTER TO THE EDITORS.

Power-Factor Indicators.

To the Editors of Electrical World and Engineer:

SIRS:—It is with interest and appreciation that I have read the communications in your issues of January 14 and February 18, concerning power-factor indicators. Both articles are valuable and interesting, because they afford a conception of this instrument from different points of view. I, however, do not quite agree with all the statements and, therefore, consider that the following remarks are in order:

When two wattmeters are employed to measure power, the ratio of the reading of one wattmeter to that of the other wattmeter gives a function of the power factor, if the circuit is balanced. Now, instead of using two wattmeters, suppose both are combined into one instrument. By arranging for the indication of power-factor values, there are available two possible combinations, namely, one current coil and two potential coils, or one potential and two current coils. The first combination of coils is used in the instrument described in my article of December 24, 1904; the second combination of coils is used in the instruments described by Mr. MacGahan, January 14. The arrangement of these coils in the instruments in either case is such as to produce a rotating field, in one instrument developed by the potential coils, in the other by the stationary series coils. In both instruments the rotating field is merely an incident; in fact, it is better entirely to ignore the rotating field. This is shown from the fact that either instrument could be split into two single-phase elements. To illustrate, take the first combination of coils. The series coils would be in two sections, one above the other, and each section enclosing a potential coil. Both potential coils would be mounted upon the shaft actuating the needle. In the second combination, the potential coil would be in two sections, one section enclosed by one of the series windings, the other enclosed by the second series winding. An iron vane for each element would be mounted upon the shaft.

No rotating field could possibly exist in either of these arrangements, yet both instruments would indicate the power factor.

The power-factor indicator does *not* depend for its action upon the rotating property of the field, but upon the components which produce that field.

The electrical parts and their *connection* into the circuit are for both combinations of coils analogous to the two-wattmeter method, and can be so explained as illustrated in my recent article.

Since it is true that both types of power-factor indicators are connected into the circuit similarly to the two-wattmeter method, it is also true that their action for securing power-factor measure-

ments may be analyzed on this basis, and that in this sense "All power-factor indicators on the market are constructed upon the principle of the ratio of wattmeter readings by the two-wattmeter method of measuring power."

The article of December 24 states that the deflection of the needle is the ratio of watts, W_1/W_2. This wording is a general statement. Strictly worded, it would be more correct, as the deflection of the needle is *a function of* the ratio of the readings of watts, W_1/W_2. This deflection depends among other things upon the shape of the magnetic field and the value of tan ϕ, where ϕ represents the angle of phase relations.

Mr. Shaw is also too literal in his interpretation of the word "indicate." This word is likewise used in a general way as a reading of the article will disclose. Of course, the two potential coils rigidly mounted on the shaft cannot each individually indicate values. This is self-evident. They, however, do *attempt* to indicate these values, the needle taking a position which is the resultant of these two forces or a function of the ratio, W_1/W_2.

The ultimate object of the article of December 24 is to disclose the similarity of the power-factor indicator to a wattmeter, and not bury it in the mystical realm of a rotating field. The article would without doubt have been more complete if the deductions had been carried further and shown how the scale is marked, but as this was not the embodying idea of the article, this feature was omitted.

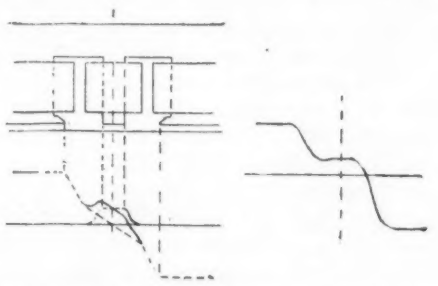
LYNN, MASS. H. W. RICHARDSON.

DIGEST OF CURRENT ELECTRICAL LITERATU RE

DYNAMOS, MOTORS AND TRANSFORMERS.

Heating of Electrical Machinery.—GOLDSCHMIDT.—A paper read before the British Institution of Electrical Engineers on temperature curves and the rating of electrical machinery. The first part of the paper deals with the cases in which an instrument or machine is used for only a short period at a time, as in the case of transformers for starting purposes, the choking coils of single-phase motors, etc. The heat developed during the time the apparatus is in use is spent almost entirely in heating up the material, and the time is too short to dissipate any appreciable amount. Given the specific heat of the material, the calculation of the temperature rise is a simple matter, and in the case of two materials, copper and iron, since their specific heat is nearly the same, we may assume an average value. The temperature increase per second is given by the formula: Temperature increase per second = watts lost in unit volume ÷ rise constant; or, in symbols: $V = Wv/Cv$, in which Cv, the "rise constant," is 3.5 in c.g.s. units and 32 in British units; that is, 3.5 watts lost in one c.c. of copper or iron raises its temperature by 1° C. per second, or 32 watts lost in 1 cu. in. of copper or iron raises its temperature by 1° F. per second. Machines which are to work for only a short time, with interruptions sufficient to allow them to cool to the tempeature of the atmosphere, must be so designed that the flux density and copper density do not exceed a certain amount, independent of size and cooling surface. The flux density is practically limited only by the permeability of the iron, and not by the heating. The author gives three tables for the heating of copper, nickeline and iron, his figures being specially useful for the calculation of starting resistances. The length of the period during which the apparatus gives out no heat to the surrounding atmosphere, depends on the kind of machine and is for revolving machines, open, 20 minutes; totally closed, 40 minutes; stationary machines, open, one-half hour; totally enclosed, one hour; starting resistances and single wires in general, one-half to two minutes. In the second part of the paper the author describes a method for determining theoretically the temperature curve of electric machinery when the final temperature attained by the machine on constant load is known. He assumes that unit radiating surface of any material, at a given temperature difference, will radiate in all cases the same amount of heat, and takes no account of the heat otherwise dissipated. The third part of the paper is devoted to a discussion of the special case of crane reading.—Lond. *Elec.*, March 17.

Direct-Current Dynamo with Commutating Poles.—A description of a dynamo made by an English company under the Phoenix-Pohl patents. The output of a given size of direct-current generators is limited by two factors—sparking at the commutator and the heat developed. In proportion as these faults can be suppressed, the weight and cost of a machine can be reduced for a given output. Some mathematical considerations are given concerning commutation. The peculiarity of the special commutating poles is that their faces decrease in breadth in the direction of motion for the purpose of equalizing the field. The commutating poles are as short as possible in the axial direction of the armature. The e.m.f. curve produced by the usual pattern of auxiliary commutating poles is shown projected in Fig. 1, while Fig. 2 shows how the e.m.f. is maintained at constant value for a considerable period in the Phoenix machine and the commutating position correspondingly enlarged. The results of some tests are given, showing the possibilities of sparkless commutation within wide limits. With respect to the heating limit



FIGS. 1 AND 2.—COMMUTATION WITH ORDINARY AND SPIRAL COMMUTATION POLES.

of the machine, special attention is paid to ventilation of both the field coils and the armature. Each field coil is wound in two parts, separated by air ducts, and a blast of air caused by the armature is driven through these passages. The armature is so constructed that air is drawn in from both sides along the shaft and forced out by fan action between every one of the end connections, and through ventilation ducts in the armature core. The temperature rise is by this means kept below 35° or 40° F.—Lond. *Eng'ing*, March 24; more briefly in Lond. *Elec. Rev.*, March 24.

Slow-Speed Alternators.—E. K. SCOTT.—A note on proportioning slow-speed alternators. In low-voltage, polyphase generators there is some difficulty in adjusting the number of poles, periodicity and cross-section of armatures owing to the comparatively small number of armature conductors in comparison with the number of poles. For example, a two-phase alternator armature is 140 in. in diameter by 16 in. long, and for a periodicity of 50 there are 70 poles at 85 r.p.m. At the voltage of 250 the number of conductors per pole would be two; that is to say, one coil per pole per phase. Now, if the speed is increased to 120, it will be found that, contrary to the popular idea, the armature core cannot be reduced in length, but must remain the same so long as the periodicity remains at 50. This is due to the fact that the number of coils must be a multiple of the number of poles, and it is not possible to have less than one coil or two conductors. Of course, if it is permissible to increase the periodicity, then the number of coils goes up in proportion with the number of poles, and the necessary voltage is attained with a reduced total flux through the armature.—Lond. *Elec. Rev.*, March 17.

Testing Turbine-Driven Dynamos.—BECK.—A note on a method of testing which has been applied in a Tyrol water power plant. This plant contains two 100-kilovolt-amp., 3,000-volt, three-phase generators, each driven by a 150-hp Pelton turbine, the speed being 750 r.p.m. The author used one of the two sets as brake. This was accomplished by reversing the direction of revolution of one of the two sets. According to the degree of opening of the water inlet valves, any desired load could be obtained. One of the methods used consisted in synchronizing the machines by means of a narrow belt which acted as an elastic coupling. Synchronism was obtained

at about half-speed when the belt was removed, so that the turbine was now revolved by one electric machine acting as synchronous motor and running in a direction opposite to the normal one. For carrying out this test, in addition to the narrow belt, nothing is required but the reversal of some of the electrical connections. All necessary curves may thus be obtained for the generator, as well as for the motor.—*Zeit. f. Elek.* (Vienna), March 12.

Voltage Drop in Alternators.—Drucbert.—The first part of an article on the application of various methods for determining the voltage drop in alternators. The following methods are dealt with: those of Behn-Eschenburg, Rothert, Potier, Heyland. These methods are applied by the author to ten different machines and the results are tabulated. The article is to be continued.—*L'Eclairage Elec.*, March 18.

Alternators in Parallel.—Henderson.—A mathematical note on the operation of alternators in parallel. The note is essentially a continuation of the treatment given in Perry's "Calculus for Engineers."—*Phil. Mag.*, March.

Lights and Lighting.

Tantalum Lamp.—Bainville.—An abstract of a paper read before the Paris International Society of Electricians. The author gave the results of some photometric measurements made by Laporte. For three different samples the consumption of watts per candle was found to be 2.05, 2.06 and 1.73, respectively. In the discussion, Korda remarked that the properties of refractory materials suitable for lamps are found united in carborundum. Attempts have been made to obtain filaments from carborundum, but so far without success. He thinks, however, that it may be used at some future date.—*L'Industrie Elec.*, March 10.

Nernst Lamp.—Turnbull.—With respect to the recent letter of Walton on the unsatisfactory behavior of the new U-type of burner for the Nernst lamp (made by the Allgemeine Elektricitäts Gesellschaft, of Berlin), the present author states that he much prefers the new type. For street lighting work the average life seems likely to prove to be over 500 hours per lamp, and he thinks that future experience will result in improvements. He thinks that for houses the life will be about the same. Lamps hanging at an angle give some trouble. One interesting result has been obtained in the works where the polarity is frequently reversed, when, in the course of the evening, the load is changed over from one side to the other for the purpose of equalizing the currents. Under these circumstances, the lamps apparently last longer than when run with constant polarity. He intends to investigate the effect of putting a reversing switch on some street lamps to reverse the polarity each time the lamp is switched on.—Lond. *Elec.*, March 24.

Nernst Lamp.—An illustrated article giving the results of photometric measurements of the Nernst lamp. The results are represented in form of a solid body, surrounding the lamp, each point on the surface of which designates the candle-power in that direction. —*Zeit. f. Beleucht.*, February 10 and 20.

Nernst Lamp.—Salomon.—A paper read before the Vienna Electrical Society on the development of the Nernst lamp. It seems not to contain anything new.—*Zeit. f. Elek.* (Vienna), February 26.

Power.

Application of Electricity to Industrial Purposes.—Snell.—A paper read before the British North East Coast Institution of Engineers and Shipbuilders. The author first gives the actual results of electric stations owned by two large shipyards. One is being operated in part by its own steam-driven plant and in part from a town supply, these two systems being entirely separate from one another. The other example is that of a shipyard supplied from its own gas engine-driven generating plant. In the first case the total cost per kw-hour was 2.16 cents, the total kw-hours generated per year being 891,655. In the second plant the cost was 2.346 cents per kw-hour, the total kw-hours generated during four months being 83,395. The author claims that in works requiring from 300,000 to, say, 1,000,000 kw-hours per annum, with a load factor of 20 to 30 per cent., the cost will be found to vary from 2.5 to 2 cents per kw-hour; and he is of the opinion that, looking at the question broadly, and taking into due account an adequate depreciation of plant and average cost of up-keep for, say, a period of 20 years, 2 cents is about the lowest limit for installations of the size stated. He then discusses the advisability of buying electric power from an outside station, especially if the plant which uses the current has a small capacity and a low load factor. Concerning the comparative advantages of direct and alternating polyphase currents, he thinks that the costs and weights of motors are in favor of the three-phase type, and that although the latter does not allow as easy a variation of speed as a direct-current motor, yet the simple three-phase induction motor is much more likely to gain favor than even its quite simple direct-current rival. He thinks that for engine works and shipyards 250 volts is a sufficiently high pressure to adopt. Wherever possible, he says, it should be the aim to group the machinery and tools in such a way as to adopt three sizes of motors, for example, 30-hp, 15-hp and 5-hp. In this way one spare armature for each type of motor will probably be found to be sufficient, and thus the capital expenditure on spares will be considerably reduced. —Lond. *Elec.*, March 3.

High-Tension, Direct-Current Power Transmission.—A note on a new power transmission plant, using the Thury system of transmitting direct current at high tension between Moutiers and Lyon, a distance of 112 miles. At the water power station at Moutiers there are to be four generating sets, each consisting of a turbine driving two six-pole series dynamos at 300 r.p.m. Each dynamo is designed for 75 amp. and 7,200 volts, and the aggregate station capacity is, therefore, 4,320 kw. Electric energy is to be transmitted for the most part at 57,600 volts by two copper wires of 9 mm. (0.354 in.) diameter, but within the boundaries of Lyon underground cables are to be used. It is anticipated that the absence of induction and resonance effects will permit the use of a cable normally designed for 50,000 volts alternating. Part of the electric energy is to be transformed in a sub-station in Lyon to continuous current at 600 volts for traction purposes, while the remainder is to be converted in a second sub-station by motor-generators to three-phase currents at 25,000 volts. Since the middle point both of the generating plant at Moutiers and of the motor plant at Lyon is earthed, the maximum electrostatic pressure between transmission line and earth is limited to 28,000 volts.—Lond. *Elec.*, March 10.

Electric Driving in Cotton Mills.—A note on what is claimed to be the first spinning mill in England to be driven electrically from the outset. It is being erected by the Acme Spinning Company, of Pendlebury, near Manchester. It will contain 41,000 mules and 34,000 ring spindles, as well as the usual preparation machinery. It will consist of six stories and is to be equipped throughout with the most up-to-date appliances known. Supply is to be given by the Lancashire Electric Power Company. Three-phase current at 10,000 volts will be taken into a special fire-proof transformer chamber, and the supply to the motors will be at 400 volts three-phase, while four-wire, three-phase distribution at 230 volts will be used for lighting. As turbines are used for driving the dynamos at the power company's generating station, a very perfect drive should be obtained on the spindles, which, of course, is a matter of vast importance in the spinning industry, for not only is increased production thus obtained, but the product itself is also improved in quality. Exactly how much improvement there will be as a consequence is one of the most important questions of the whole subject, the steam engine makers insisting that with their most modern plant no cyclic irregularity occurs. As, however, this new mill is being built side by side with a steam-driven mill of the same proportions and under the same management, a very useful comparison will be instituted.—Lond. *Elec.*, March 3.

Gas Turbines.—Lucke.—An article on practical investigations of the gas turbine problem. The author examines the thermodynamic principles involved in such devices, and shows, as the result of exhaustive experiments conducted in the mechanical laboratory of Columbia University, that this conversion is not affected by free expansion in simple nozzles. A portion of the potential kinetic energy developed by the combustion, and readily transformed into work when the products of this combustion are allowed to expand in the cylinder of a reciprocating engine, is not so recovered when these same products expand through the nozzles of an ordinary turbine, and the difference is so great as to make the latter a failure commercially. The situation may be summed up by saying that so far no work has been done that warrants any assumption of equivalence between gas turbine and gas engine, and the difference is so great that the pure gas turbine provided with the simple nozzles used by steam turbines is a failure commercially and can never rise above this until some method has been found to make results by free ex-

pansion more nearly equal to those obtained in cylinders.—*Eng'ing Mag.*, April.

Steam Turbines.—FEDDEN.—An account of the results of steam turbine and boiler tests at the Neepsend generating station of the Sheffield Corporation. The boilers and turbo-generators have been in regular service for about five months. The two two-phase turbo-generators are of the revolving armature type, and were specified to give an output of 1,500 kw at 2,000 to 2,200 volts and 50 periods per second with a power factor of 0.85. After running for five months at 16 hours per day and six days a week, during which time the normal load has been about 1,000 kw during daytime and 1,400 kw to 1,600 kw during the dark hours before 11 p.m., an average was taken for ten weeks—November 20 to January 22—with the results shown in the following table:

At stop valve				Steam used per hr.		
Press. abv. atmos. in lbs. per sq. in.	Superheat in degs. F.	Vacuum in inches.	Speed r.p.m.	Load in kw.	Lbs.	Lbs. per kw.
190	100	27	1,500	979	21,850	22.41

Steam Engines.—CAPPER.—The first part of a paper read before the British Institution of Mechanical Engineers. It contains the first report to the steam engine research committee which was constituted at the instance of the late Bryan Duncan to investigate and carry out researches upon the initial condensation in steam engine cylinders.—Lond. *Eng'ing*, March 24.

TRACTION.

Permanent Way Construction.—LORD.—A paper read before the Leeds Section of the British Institution of Electrical Engineers on tramways, permanent way construction and maintenance. The author first gives some notes on specifications for rails and on concrete construction. The mixture he uses is five parts of broken gritstone, one of clean, sharp sand and one of best Portland cement turned over twice while dry, then turned twice after water has been added. He thinks that every engineer having under his control the construction and maintenance of permanent way should have possession of an emery rail grinder. The one he has is very complete; it is equipped with an electric motor so that it can travel and work from the overhead wire; it is also fitted with a 12-hp petrol motor and can travel and grind from this if the overhead equipment is cut off or if it has not yet been completed. The machine is fitted with carborundum grinding wheels carried by compound slides constructed so that the grinder may be moved longitudinally, transversely and vertically to the rails to be ground; both rails can be ground at one setting. With respect to the bonding of rails, the author emphasizes that the nearer one can approach a continuous rail the better will be the conductivity and the less danger from electrolysis due to stray currents in gas, water and other metal pipes. He had made some tests of the electric resistances of joints made by the thermit and other processes with the following results:

Taking a solid rail 8 ft. long as a standard resistance	0.000067 ohms.
With thermit-welded joint, without bonds, same length	0.000072 "
With thermit-welded joint, with one bond, same length	0.000067 "
Fishplates, sole-plate and two bonds, newly constructed	0.000078 "
Fishplates, sole-plate and two bonds, after two years	0.000095 "

The welded joint has a considerable value mechanically by giving increased strength to the track. In proof of this the author mentions that he has made a number of tests, and in all instances the rail has broken and not the joint. The layout of the curves is an important item in the maintenance account, as will be gathered from the following instance: The author had a curve with a radius of 30 ft., the wheel base of the car was 5 ft. 6 in.; this curve never lasted a longer period than six months, but some 2½ years ago this was altered to a 45-ft. radius, and it is in good condition to-day. On many of the curves, which are of 35 ft. radius, a new check rail must be installed about every nine months.—Lond. *Elec.*, March 10.

Tube Line.—JONES.—The conclusion of his illustrated paper on working results obtained on the Waterloo & City Railway in London, with some editorial remarks on the subject. The traffic conditions are not favorable to high economy, especially as regards the power supply, and under the circumstances the cost of 1.838 cents per unit generated is creditable. The traffic conditions, which are expressed by curves, have been well met by the use of four-car and single-car trains during the heavy and light load hours, respectively, with the result that the train load factor is kept up to a very satisfactory level, and the working expenses are less than 48 per cent. of the receipts. "These are excellent results, comparing very favorably with other lines, although comparisons are difficult." Jones has been compelled to adopt the unit of "train-ton-mile" instead of the orthodox "train-mile," and has also used the passenger-mile unit. "That two and a quarter train-ton-miles are run for every passenger-mile is a striking fact."—Lond. *Elec.*, March 3.

Fuses Versus Circuit-Breakers.—EDWARD TAYLOR.—A discussion of the relative merits of circuit-breakers and fuses for the protection of railway apparatus. The author points out the conditions for which each is best adapted. He thinks that only by the use of both protective devices conjointly is it possible to protect a railway motor against short-circuits and sudden or continuous overloads.—*St. R'y Jour.*, March 25.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Rates of Charging for Electrical Energy.—STERN.—A paper read before the Vienna Electrical Society. The author discusses briefly a great many different systems of charging. He thinks that a multiple tariff, with rates differing according to the time when the energy is used, would in general lead to a reduction of the receipts of the company. To increase the consumption it is necessary to make specially favorable rates for energy used during hours of light load. It is a mistake to believe that a motor load is in general specially favorable. The time during which motors are used is not considerably greater than that during which lamps are used. From the statistics of German electric plants he has tabulated all cities with more than 200,000 inhabitants and has found that the average time of using the connected lamps is 468 hours in a year, and that of using the connected motors 476 hours. In a Vienna central station the corresponding times were 590 hours for motors and 670 hours for lamps, the load factor being 20.6 per cent. for motors and 23 per cent. for lamps and motors together. It is, of course, quite different with motors which are guaranteed not to work during night hours, this being accomplished, for instance, by means of a switch which turns off the current at a predetermined hour.—*Zeit. f. Elek.* (Vienna), February 19.

Electric Supply Accounts.—An article on the New Castle-upon-Tyne Electric Supply Company's accounts. The total kw-hours sold by the company during the year 1904 amounted to 17,132,153, which represents an increase of nearly 100 per cent. over 1903. Of the 17,000,000 units two and a half millions were sold for lighting, six millions for power and eight and a half millions for traction and "in bulk." The total costs per kw-hour sold were 1.804 cent in 1903 and 1.332 cent in 1904.—Lond. *Elec.*, March 10.

Taxes of Central Stations.—HICHT.—An article discussing the taxes levied in Australia on municipal stations which furnish light to private consumers.—*Zeit. f. Elek.* (Vienna), February 26.

WIRES, WIRING AND CONDUITS.

Electric Cables.—ATKINSON AND BEAVER.—Continuation and conclusion of their illustrated paper on the selection of electric cables, the first parts of which were noticed in the Digest April 1. The

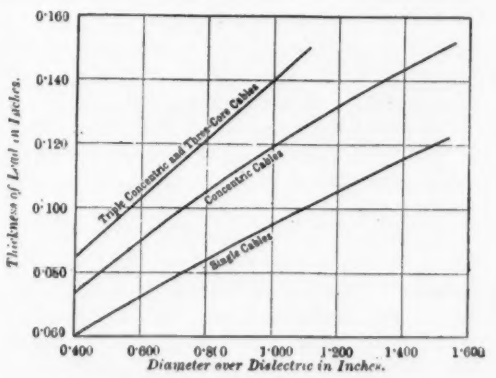
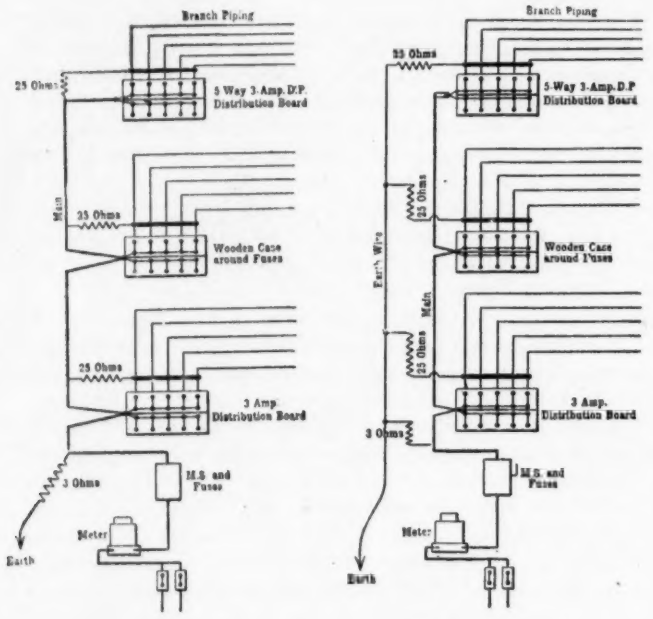


FIG. 3.—CURVES OF CABLE TESTS.

authors state that the matter of testing paper for admixture with the woody classes of fibre presents no difficulty to those having an elementary knowledge of the microscope. The preparation consists in merely extracting the insulating material with a solvent such as benzol, boiling the paper in a weak alkaline solution, washing with water and testing out the fibres with needles, and mounting in the usual way in glycerine, or in a special reagent, which, by its differ-

ential action on various fibres, colors them distinctively according to the class to which they belong, thus aiding the identification. Various illustrations of micro-photographs are given which show the characteristic forms of the fibres to be specially avoided. As the final insulating property of the dielectrics depends upon the exclusion of moisture, the lead envelope is very important. Concerning the thickness of this envelope the British engineering societies and the Cable Makers' Association have decided to use as minimum thicknesses those given in Fig. 3. Some notes are given on corrosion and especially on electrolytic action. There are two appendices to the paper, one dealing with Glover's test for tinned high-conductivity copper wire, while the second one gives a general specification for lighting and power cables for pressures up to 500 volts.—Lond. *Elec.*, March 3, 10.

Earthing in Three-Wire Systems.—LACKIE.—A paper read before the Glasgow Section of the British Institution of Electrical Engineers. The author states that gas pipes should not be used as earth connections; the water pipe is almost universally used. He refers to the experience which he has had at Glasgow and which has led him to the conclusion that the present method of earthing directly at any point is wrong. He formulates his conclusion in the following three proposals: First, that the metal sheathing on installations for connection to public supply mains should be kept clear of other



FIGS. 4 AND 5.—EARTHING OF THREE-WIRE SYSTEMS.

metal work throughout the entire run of the conductors; second, that the connection to earth should be through a resistance of such an amount as would allow not more than, say, two or three times the normal current of the installation to flow to earth in the event of one of the conductors coming in contact with the sheathing; third, that the metal sheathing on installations for connection to public supply mains should be joined to earth at one point only. The author discusses these three proposals, one after the other. Concerning the resistance in the earth circuit, he says that it would reduce enormously the rush of current, resulting in only a small branch fuse melting, the main fuse remaining intact; i. e., where the fault, or earth, occurred in a branch circuit. He thinks it would be even a better arrangement if each set of branch pipes had a proportionate resistance inserted in a circuit to a separate, slightly insulated earth wire and a sheathing of the mains had also a resistance, as shown in Figs. 4 and 5. With respect to these proposals it is said in an editorial note that Raphael suggested earthing the iron barrel, or sheathing, on each consumer's premises through a fuse, which held up a connecting bar above two metal strips connected through a small resistance to each pole on the consumer's side of the main fuse. When a bad leak occurred the fuse in the pipe circuit melted and released the short-circuiting bar, so that the cost of the simple magnet and the resistances which are in circuit only momentarily would be far less than that of the substantial resistances proposed by Lackie.—Lond. *Elec.*, March 10.

ELECTROPHYSICS AND MAGNETISM.

Dielectric Hysteresis.—GUYE AND DENSO.—A paper giving the results of some measurements of the heat developed in paraffine when subjected to the action of a rotating electric field. These tests complete the series of facts necessary to establish the existence of dielectric hysteresis as a quantitive matter. The apparatus consisted of four metallic armatures arranged in a square and embedded in paraffine. Between these four armatures was produced a rotating electric field whose circular character could be minutely verified. The heat disengaged was measured by means of an iron constant and thermo-couple whose hot junction was placed in the center of the rotating field, while the cold junction was placed in a similar apparatus unconnected with a source of electricity. The results show that for the same frequency the energy disengaged in the form of heat is proportional to the square of the pressure, as in the case of slow alternating fields. For the same pressure the power consumed and converted into heat is proportional to the frequency. The ratio between the power absorbed in the rotating field and that absorbed in the alternating field, both having equal pressure and frequency, is about 2.56.—Lond. *Elec.*, March 3; from *Comptes Rendus*, February 13.

Transparent Iron Films.—HOULLEVIGNE.—A note on the production of transparent iron films by the "ionoplastic" method, in which the iron is deposited by cathode disintegration; in attempting to measure the thickness of such films serious difficulties are encountered. The author has devised a purely optical method, in which the error does not exceed 25 per cent. The method consists in measuring the transparency of the film in a Lummer-Brodhun photometer. Since the light transmitted by the film is grey it absorbs all rays equally, and the absorption is proportional to the thickness. The coefficient connecting the absorption and the thickness is determined by a calorimetric method (dissolving the iron film in aqua regia and comparing the color with that of a standard solution of a known ferric salt). Thus the author found for a film of 0.024 mg. per sq. cm. a thickness of 39 $\mu\mu$ and a transparency of 0.114. With a film of 0.056 mg. per sq. cm., the thickness was 72 $\mu\mu$ and the transparency 0.0093; this transparency is, however, subject to a correction for reflection.—Lond. *Elec.*, March 3; from *Comptes Rendus*, February 13.

Shrinkage of Earth's Magnetism.—BAUER.—An American Physical Society paper in which the author shows a shrinkage of the earth's magnetic moment for the period from 1890 to 1900, which has been about the same as that deduced on the basis of the magnetic charts for 1843 to 1885. Adopting the mean of the two ratios he finds that the earth's magnetic moment has been shrinking since 1840 at the rate of about one twenty-four hundredth part of its prevailing value annually. He also arrives at the conclusion that the secular variation of the earth's magnetism results not only from a change in the direction of the axis of magnetization, but also from a change in the intensity of magnetization.—*Phys. Rev.*, February.

ELECTROCHEMISTRY AND BATTERIES.

Alternating-Current Electrolysis.—BROCHET AND PETIT.—An account of experiments in which the authors analyzed certain organic acids by means of an alternating current and obtained a high efficiency. They used a test tube containing about 150 c.c. of solution and ribbons of platinum as electrodes, the mean current density being 1 amp. per sq. cm. The solutions used included solutions of the formates of potassium and barium, and acetic and oxalic acids. With the potassium formate the results are extremely variable, and the electrodes are rapidly covered with a light deposit of carbon. The efficiency rapidly diminishes, and it is necessary to make the measurements quickly, and to calcine the electrodes after each experiment. The carbon obtained does not adhere to the electrodes, but spreads through the liquid and gradually falls to the bottom. The gas developed is nearly pure hydrogen, with a very slight admixture of oxygen and carbonic acid. The efficiency is 80 to 90 per cent. The barium formate gives about 65 c.c. per minute of a mixture of hydrogen and carbonic acid, the efficiency being about 75 per cent. There is practically no oxide of carbon disengaged. The analysis is in every way similar to direct-current analysis.—Lond. *Elec.*, March 3; from *Comptes Rendus*, February 13.

Slimes.—BETTS.—An illustrated article in which the author first gives some analyses of commercial slimes and discusses the processes in use at present for their treatment. He then describes a new

process which is electrolytic, and for which lower cost and better results are claimed. The process is described in detail and illustrated by diagram.—*Electrochem. and Met. Ind.*, April.

UNITS, MEASUREMENTS AND INSTRUMENTS.

British National Physical Laboratory.—An account of the annual report for 1904 of the British National Physical Laboratory. The work done in the department devoted to fundamental units related mainly to standards of resistance, standard cells, especially methods of preparing mercurous sulphate, and the construction of the electrical portions of the ampere balance of the British Association. In the department for general measurements an exhibit of numerous instruments of British manufacture, at St. Louis, were tested before they were shipped to the United States. Numerous tests were also made on laboratory instruments. For hysteresis tests a Searle ballistic wattmeter was set up, and by its help a measurement of hysteresis was obtained by observing four throws of the moving coil—a considerably quicker method than the standard one of drawing the hysteresis loop and measuring its area. As this wattmeter must be very sensitive, considerable difficulties arose with it in the earlier part of the work. After tracing and eliminating several sources of error, the wattmeter method has been used to test a number of rings, and so far the results have been in good agreement with those given with the same rings by the ordinary ballistic galvanometer method. Some comparison tests were also made on an Ewing hysteresis tester. Progress has been made during 1904 in the equipment of the electrotechnical department to undertake the testing of electrical apparatus on a commercial scale, and it is hoped that early in 1905 the installation of the necessary apparatus will be complete. In the thermometry department the chief research work has been the commencement of a study of the resistance and thermoelectric properties of solid electrolytic conductors, such as are used in Nernst lamps, with a view to the design of a system of electrical high-temperature measurements based on some of the properties of these materials. Tubular electric furnaces have been constructed capable of continued use at temperatures well above 2,000° C. By means of these furnaces and a number of thermo-junctions of widely different properties, whose e.m.f. in terms of the standard temperature scale up to 1,300° C. had been previously determined by extended comparisons with the laboratory standards, a careful determination of the melting point of platinum was made. The existence, at high temperatures, of large thermo-electric forces between rods of the various earths, made up and treated as ordinary thermo-junctions, has been securely established by direct electrometric methods, and the apparatus necessary for a detailed study of these phenomena is in course of construction. In the photometrical department investigations on the 10-cp Harcourt-Pentane lamp, which were begun in the latter part of 1903, have been completed during the past year. The following formula, showing the variation in candle-power with humidity and barometric pressure, as found experimentally, enables the standard to be used in photometric comparisons in which the test lamp is unaffected by atmospheric conditions. Candle-power $= 10 + 0.066\ (10 - e) - 0.008\ (760 - b)$ where e = liters of moisture per cubic meter of pure air, b = barometric pressure in millimeters. In the department for steam research, the first piece of work undertaken is the determination of the specific heat of superheated steam.—Lond. *Elec.*, March 24; Lond. *Eng'ing*, March 24.

Electricity Meters.—GERHARDI.—Continuations of his illustrated serial in which the author now discusses direct-current meters. The following types are dealt with: The Acme meter, the Bastian meter, the Eclipse meter, the Electrical Companies' meters, the Ferranti meter and the Hookham meter.—Lond. *Elec.*, March 3, 10, 17 and 24.

Localization of Faults on Cables.—Several communications, of which one describes, with the aid of diagrams, simple and reliable drop in potential methods.—Lond. *Elec. Rev.*, March 17 and 24.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wireless Telegraphy.—Last year the British Government passed a wireless telegraph act, restricting the use of wireless telegraphy to persons who are properly licensed by the Post Office. The interest of the following four government departments had to be safeguarded: Post Office, Trinity House Board, War Office and Admiralty. The draft licenses are now ready and have been submitted to those who applied for licenses last year. An account of the same is given. Three classes of licenses have been prepared: commercial, experimental and private business. The commercial license appears to limit a company to communication between ships and shore stations and to overland work. It is further provided that the licensee shall not work his apparatus so as to interfere with the working of other stations used for commercial purposes, or for communicating with ships at sea or with those belonging to a government department. The means for preventing interference must apparently be devised by the licensee himself. No penalty is provided for infringement of this clause of the agreement, except the revocation of the license. The Admiralty has special rights for the protection of naval signaling.—Lond. *Elec.*, March 17.

Wireless Telegraphy.—A note giving an abstract of a pamphlet of Prof. A. Artom, of Turin, who attempts to produce and utilize circularly or elliptically-polarized electromagnetic waves, instead of the customary plane-polarized radiation. There are at the sending end two spark-gaps arranged perpendicularly to one another, both put into operation by the same induction coil, but thrown out of phase by the inclusion in one spark circuit of inductance or capacity. One of the balls is connected to an air wire, which it is presumed by the inventor radiates elliptically-polarized waves. Now, according to Artom, elliptically-polarized waves can be given a determinate direction more easily than can plane-polarized waves. "We do not know how the directing is accomplished, but the experiments in the pamphlet under notice appear to have proved that signals can be sent 300 km. to the west without affecting a station—in tune, we have to suppose—only 100 km. south of the sender. Notwithstanding all this, we find it difficult to see how, in the fifst place, elliptically-polarized waves are detached from a vertical air wire or air wires, and how, in the second place, the elliptic character is retained during propagation in spite of the inevitable and rapid dissipation of the horizontal component at the surface of the earth. We are forced, in fact, to the conclusion that only plane-polarized radiation of the ordinary type can reach the receiving station, and thus that the success of the recent experiments is due to the mode of directing rather than to the character imparted to the waves."—Lond. *Elec.*, March 10.

MISCELLANEOUS.

Cost of Manufacture.—WEST.—The author states that he was recently consulted by some prominent firms, the sales of which had diminished during recent years in spite of their good reputation. He found that this reduction of sales was due mainly to a wrong calculation of the cost of manufacture. In many cases orders were refused on account of a wrong method of calculating the cost. He discusses how the cost should be determined.—*Zeit. f. Elek.* (Vienna), February 19.

Gravitation.—FOEPPL.—An account of experiments in which the author endeavors to discover whether rapid motion may have an effect upon the transmission of gravitational attraction. For this purpose he suspended a weight within a few millimeters of a fly-wheel 50 cm. in diameter, which weighed ½ cwt., and could be given a tangential velocity of 60 meters per second. The fly-wheel was cased in tinned iron in order to prevent the effect of air vibrations and air currents. The author obtained a deflection due apparently to increased attraction, which amounted to a few thousandths of a millimeter. He is, however, convinced that this result is due to observational errors, though he is unable to account for them, especially since the deflection does not increase when the vibration of the supports increases. He repeated the experiment with a torsion balance enclosed in a cardboard box, and then obtained no perceptible deflection.—Lond. *Elec.*, March 3; from *Phys. Zeit.*, February 15.

Electrical Exhibition.—An illustrated account of the Holborn and Finsbury exhibition which has been organized by the County of London Electric Supply Company, for providing consumers and residents in the company's areas of supply with an opportunity of inspecting the latest developments in electric lighting, heating and power appliances.—Lond. *Elec.*, Mar. 24.

Action of Radium Emanation on Poisons.—PHISALIX.—An account of experiments in which he found that the poison of the viper, after an exposure of 50 to 60 hours to radium rays, completely loses its poisonous character. A similar action takes place on the poison of the cobra, although it is well known that this poison resists the action of heat much longer than that of the viper. Curiously, radium emanation has no effect on the poison of the lizard or the common toad. Indeed it only appears to decompose albuminoid poisons. This fact indicates a new means of investigating the constitution of poisons.—Lond. *Elec.*, Mar. 10, from *Comptes Rendus*, Feb. 7.

BOOK REVIEWS.

REGISTRATION OF TRADEMARKS UNDER THE NEW TRADEMARK ACT. By Arthur P. Greeley. Washington: John Burn & Co. Price, 50 cents.

This is a pamphlet dealing with the new trademark act, which took effect April 1, 1905, and which is reprinted in full. A history is given of the trademark act, its meaning made clear and the procedure given for obtaining registration under its provisions. It is pointed out that if trademarks are not already registered, the advantages of the act may be secured for their protection, re-registration not being necessary.

DIE ASYNCHRONEN DREHSTROMMOTOREN. By Dr. Gustav Benischke. Braunschweig: Friedrich Vieweg & Son. 172 pages, 112 illustrations. Price, 5.50 marks.

In this small book of only 162 pages the author has endeavored to, and admirably succeeded in, presenting the subject, "Non-synchronous polyphase motors."

He gives the essential formulæ without their derivation for the reason, as he states, that but a small percentage of engineers care to undertake the laborious process of developing each one of them, especially as by far the greater number of engineers are engaged only in the installing, maintaining and operating of motors. Those who wish to develop these formulæ the author refers to several books of well-known writers on the subject. Without sacrificing accuracy he has handled the subject in a simple manner. The strength of this work lies in its clear presentation and in the interpretation of each formula. The busy engineer has not always the time to analyze a formula, while others in the attempt may form wrong conclusions. As this analyzing is done for the reader, a complete and correct idea of the action or condition is presented to him before he goes from one formula to another. The result is that in a short time he obtains a clear understanding of the action and behavior of these motors and their characteristics. The subject is developed and explained under the following subdivisions: (1) Action of non-synchronous polyphase motors, (2) the circle diagram, (3) methods of starting motors and speed regulation, (4) the non-synchronous motor under abnormal circuit conditions, (5) testing of efficiency, losses, slip, etc.; (6) calculation and design of polyphase motors. The book has 112 figures printed in the text and two plates. The author fully accomplishes his purpose and the book will prove a desirable reference for those interested in the subject.

BERECHNUNG UND ENTWURF ELECTRISCHER MASCHINEN, APPARATE UND ANLAGEN. Vol. I. By Dr. F. Niethammer. Stuttgart: Ferdinand Enke. 576 pages, 472 illustrations. Price, 16 marks.

The above is the title of a work to be published in five volumes, by Dr. F. Niethammer. It is intended for the use of students and practical engineers. The second part of the first volume has just appeared and deals with the determination of the mechanical dimensions and details of electrical generators and motors, transmitting means and foundations for the same.

In his preface to the work the author states that it is his intention to deal with the subject in a systematic and exhaustive manner, to discuss questions which his wide practical experience deems essential for the preparation of a student and the young engineer to efficiently equip him for the problems which occupy engineering firms at the present time.

He introduces the subject by enumerating the conflicting requisites which confront the designer of electrical generators, and lays the necessary stress on the increasing importance of sound mechanical design of these generators and motors.

Such design, of course, involves the knowledge of the characteristics of all the materials entering in the construction. Therefore, the first chapter of this part covers the permissible stresses and other data such as coefficient of expansion, specific gravity, etc., for these materials. Then the most important insulating materials are treated from various standpoints, such as breakdown under electrical pressure, and influence of temperature and moisture upon them.

In the succeeding chapters the different parts of the dynamo are considered in a systematic manner. After giving a clear description and essential requirements of the part which is shown by a well-selected set of illustrations, the author calls attention to specially favorable construction and determines the mechanical dimensions in the well-known manner according to the resolution of forces and the calculation of strength of materials, closing a chapter occasionally with simplified formulæ for obtaining approximate values, at times collecting the desirable data in the form of a table.

The book is up-to-date and covers besides belt-driven and direct-connected machines of medium size, fly-wheel dynamos and steam-turbo-generators. On account of the high velocity of this latter type of machine, which differs in many particulars from older constructions, special attention has been given to this latest of modern types under "Bearings for High-Speed Shafts," which section is also provided with numerous illustrations. Among other points may be mentioned the determination of the critical circumferential velocity of these dynamos, which causes great flexure even with small eccentricities, but which flexure decreases at higher or lower velocities.

In the chapter on armatures he treats and determines the mechanical dimensions of shafts, bearings in all their different forms, such as smooth, roller and ball bearings, and the armature core. Following the bearings the armature body proper is considered, its ventilation, the supporting spider, its construction and determination of its dimensions to withstand the various stresses to which it is subject when the machine is in operation. The commutator brush holder and windings come in for their share of consideration. Considerable space is given to the field magnet and a very careful treatment is presented for the determination of the strength of the field magnet frame to enable it to withstand the mutual magnetic pull between it and the armature. The author lives up to his promise of complete treatment by adding the determination of the mechanical dimensions of other mechanical accessories, such as pulleys for belt or rope driving, gears, belt-tighteners, couplings, screws and nuts. The compiling of these latter data in connection with the electrical subjects is good and time-saving. This volume concludes with an enumeration of various types of foundations and price determinations of a machine which is illustrated by an example.

This work will prove to be of interest and help to students and engineers, especially to those entrusted with the mechanical design of dynamos and motors.

The fourth edition of Miller's "American Telephone Practice" has been issued. The work has been entirely reritten, and the contents have been increased from 530 pages and 379 illustrations to 904 pages and 643 illustrations. The price of the new edition is $4.00.

An Australian Electrically Equipped Drawbridge.

THE Pyrmont and Glebe Island drawbridges, both of which connect important centers of population, have been completely electrically equipped by the Australian General Electric Company, and are to-day, probably, the finest examples of electrically-operated drawbridges. As the bridges themselves and their electrical equipment are almost identical, a description of one only (the Pyrmont bridge) need be given.

From an electrical point of view the most interesting part of the bridge is the equipment provided to operate the swing span, the end lifts and the gates. The length of the swing span is 223 ft. and its weight about 900 tons, and although there may be larger electrically-operated swing spans, we believe this to have been the first installation where *all* of the operations in connection with a drawbridge are performed by electric motors, controlled by one man from one point.

The power to operate the bridge is supplied from the large power station of the Sydney Tramways at 500 volts direct current.

For slewing the bridge, two series-wound motors are provided, and the bridge can be opened in 30 seconds if desired. Such quick work has been found unnecessary, however, and the average time taken is 50 seconds. It is interesting to note that to open the bridge in 60 seconds requires a maximum of 15 hp and to open it in 30 seconds requires a maximum of 89 hp. It has been found possible to open and close the bridge with one motor, but for the sake of economy two are used, which are never taken beyond the series position of the controller. These motors are carried on a platform inside the drum and operate two vertical shafts through a train of cut gears. On the lower ends of the vertical shafts are cast steel pinions meshing with a cast steel rack secured to the top of the pivot pier. The motors are shown in position in Fig. 1.

An ingenious latch shown in Fig. 3 is used to stop the swing span in its true position upon the abutment piers. The latch is provided with heavy coiled springs so that should the moving mass be traveling at too high a rate of speed it will jump the latch without jar and may then be returned to its true position. The design of this latch to stop a mass of 900 tons, sometimes moving at a considerable speed, required much care, and the operation of the device has been thoroughly satisfactory in practice.

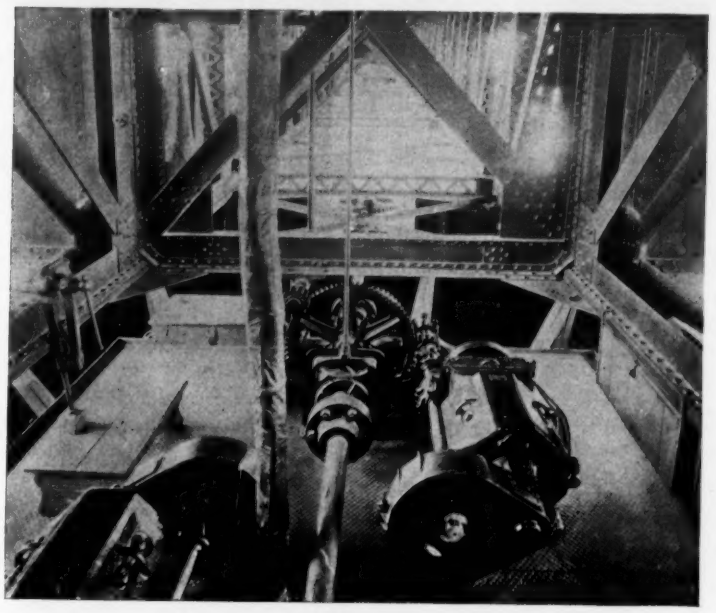


FIG. I.—MACHINERY ROOM, SHOWING MOTORS AND GEAR.

The ends of the swing span when free of supports have a deflection of 3½ in., but when closed and to prevent chattering under heavy loads, the ends are raised 1¼ in. by means of a General Electric 1000 motor, which is geared to a longitudinal shaft running the entire length of the span and working two horizontal shafts carrying cams under each main girder. This operation takes 15 seconds. An automatic device is provided for opening the circuit, and for stopping the end lifts when they have reached the correct position by means of a solenoid brake on the motor armature shaft. The end lifts are shown raised to their fullest extent, in Fig. 4. The end lifts are also shown in Fig. 3.

Each of the four gates on the abutment piers is operated by a General Electric 5-hp motor completely enclosed and connected by beveled gears to a screw shaft. A nut threaded upon the screw shaft communicates the motion through a slotted crank to the gate axis. Contacts are also supplied for automatically stopping the gates in their proper position, and automatic latches for locking them.

All of the operations connected with the moving of the swing span, the raising and lowering of the end lifts and the opening and closing of the gates, as well as the control of the 25 General Electric arc lamps on the bridge and protecting platforms, is performed from the controller house, situated above the footpath at the center of the swing span. This house, which is completely equipped with apparatus furnished by the Australian General Electric Company, is shown in Fig. 2, which also gives a very good view of the bridge open. The house contains a type K controller for every operation, with the necessary resistances located in the roof. Switches, circuit-breakers and ammeters for showing the amount of current taken for each operation, are also provided, together with a Thomson integrating wattmeter for recording the total consumption of current, and dial indicators showing the operator the position of the swing span and the end lifts. All of the operations are handled by one man, so that the expense for labor is kept at a minimum.

The six arc lamps on the protecting platforms are provided with ruby globes as a guide to vessels passing through the draw at night.

In the two years ending June 28, 1904, the swing span has been opened 12,317 times for the passage of 21,758 vessels, involving 98,536 individual gate movements. The cost of the current for operating the swing span, the end lifts and the gates for the two years has been but $235 at two cents per unit. This is a little less than two cents for each complete operation of opening and closing the bridge, with the attendant operations of moving the end lifts and opening and closing the gates. Notwithstanding the mechanical and semi-automatic operation of the gates, no accident has occurred, although the average daily traffic over the bridge totals 11,825 pedestrians, 5,288 vehicles and 7,645 head of livestock.

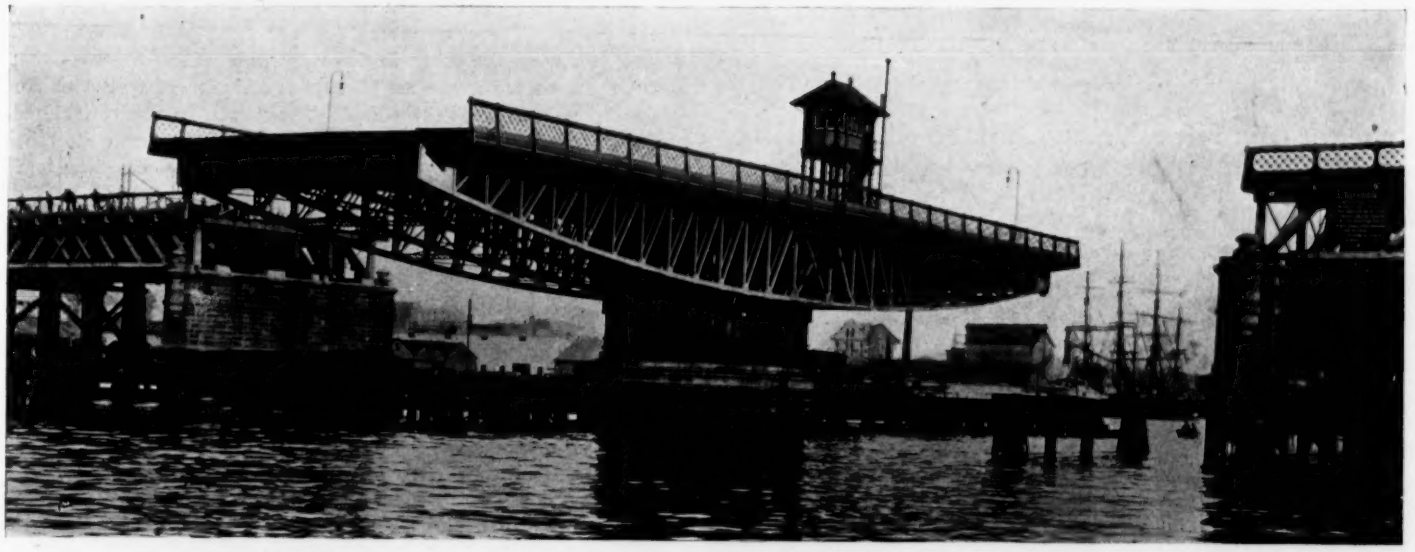


FIG. 2.—PYRMONT DRAWBRIDGE.

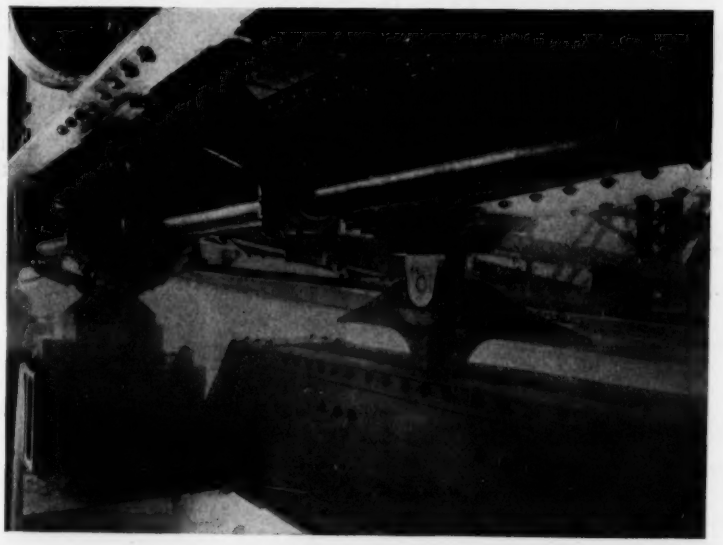


FIG. 3.—LATCH AND CATCH STOPPING SPAN.

The design of the swing span, bridge and approaches and the work of construction were under the immediate supervision of Mr. Percy

Allen, to whom is due all credit for the eminently successful results which have followed its opening over two years ago. The installa-

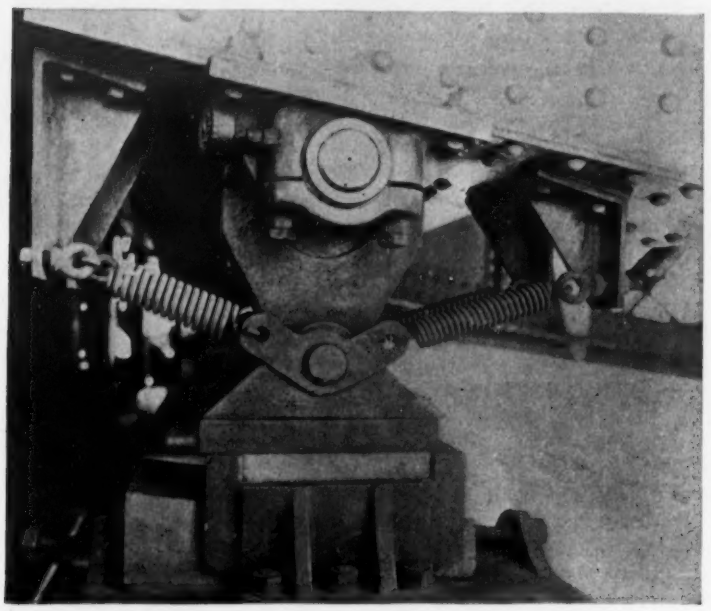


FIG. 4.—END LIFTS RAISED TO FULL HEIGHT.

tion of all of the electrical machinery was carried out by the Australian General Electric Company.

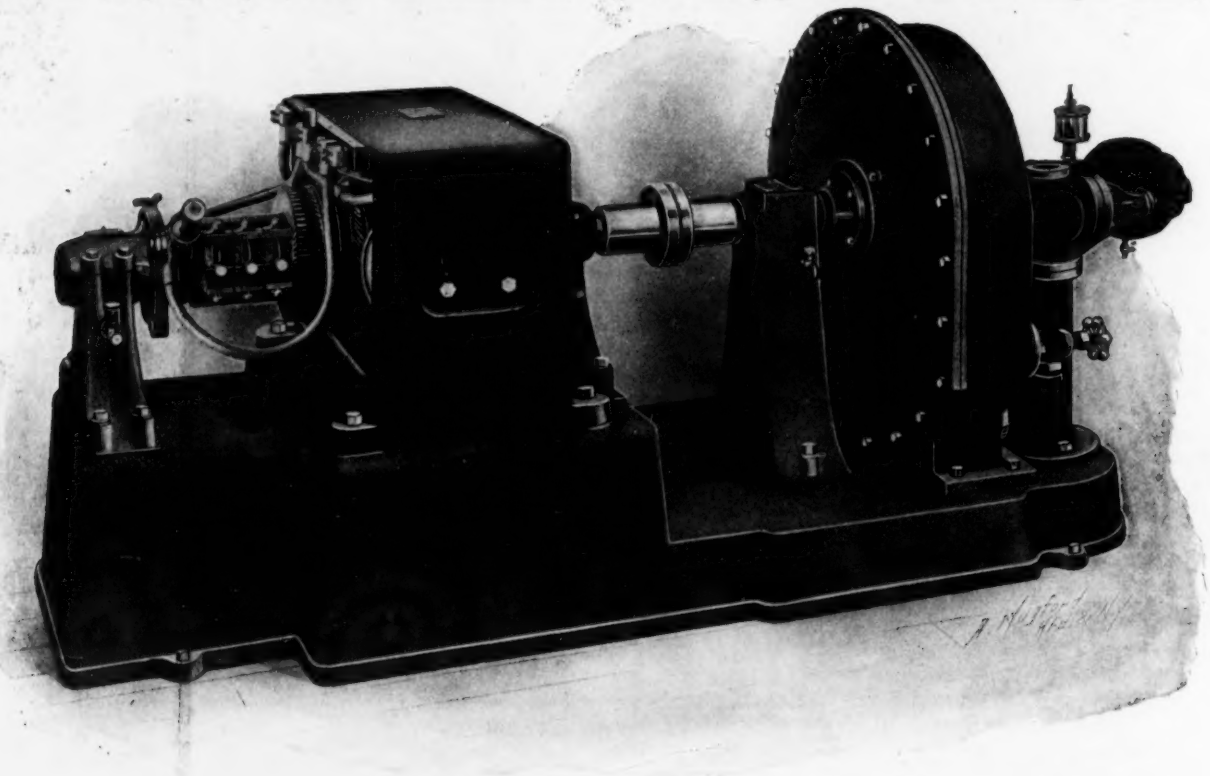
Crocker-Wheeler-Terry Turbo-Generating Set.

The 30-hp steam turbine direct-current electric generating unit, shown in the accompanying illustration, was designed and built by the Crocker-Wheeler Company, Ampere, N. J. The turbine is the invention of Mr. Edward C. Terry, Hartford, Conn. In the generator it was not found necessary to introduce any special features to help out the commutation, which is well taken care of by the standard Crocker-Wheeler design. While the ring that carries the plain carbon brushes is provided with means for shifting them, adjustment has been found entirely unnecessary. The generator has carried loads ranging from zero to full load for many hours at a time with absolutely no sparking. Overloads of 50 and 75 per cent. have been carried for half an hour without sparking. A factor favorable to the sparkless commutation is the ample brush contact surface.

A long commutator running at 2,500 r.p.m. offers no small difficulties to the designer. This one is well within the safe limits, as was shown by running the completely wound armature at a speed of 4,500 r.p.m. A microscopic examination of numerous parts of the armature and commutator showed that the stresses in no part had approached the elastic limit.

In the turbine the force producing rotation is directed tangentially to the periphery of the wheel, completely avoiding the end thrust present in all forms through which the steam passes parallel to the axis. The velocity of the moving steam is not all absorbed in a single impact or on a single bucket. The buckets on the wheel are confronted by similar stationary buckets or reversing chambers, which return the steam to the wheel after each rebounding until all of its effective energy has been abstracted. The wheel consists of two steel discs secured to a cast-steel hub on the shaft and bolted near their circumferences where they clamp the forged buckets. The reversing chambers are fastened to the case and are grouped in sets of four, each group being supplied by a separate jet. These jets are each operated by a valve, thus enabling one or more jets to be closed and the others to be used to their full capacity, when less than full load is required of the turbine

The buckets and reversing chambers are essentially flat semi-cylinders with their open sides facing one another. They are formed of plates on the broad sides, with curved walls set at right angles to the plates. These chambers are arranged in a circular series, lapping one upon the other in the form of a series of steps—that is to say, the axes of the several buckets and chambers are set obliquely to the circumference of the wheel. Their open edges are inclined at a slight angle with the axis of the shaft, so that steam after being reversed in each chamber is delivered to the next succeeding bucket, this being repeated four times. Steam issuing from jet passes to bucket, and from bucket to reversing chamber, back again to bucket, etc., until finally it escapes through a crescent-shaped hole in central part of reversing chamber. The wheel being in motion, this action does not take place between same reversing chamber and same bucket.



TURBO-GENERATING SET.

In this manner the problem is overcome which has proved a difficult one in the development of the steam turbine, because the high velocity of the steam makes it impracticable to impart its energy to the rotating element at one impact, as is done in the case of the

water wheel. If it were attempted to do this with a steam turbine, the velocity of the wheel would be so high that it would introduce complications such as excessive friction and difficulty in reducing the speed to a practicable value for transmitting, but by using the steam through four buckets before consuming its full energy a speed of one-fourth is possible with the maximum efficiency.

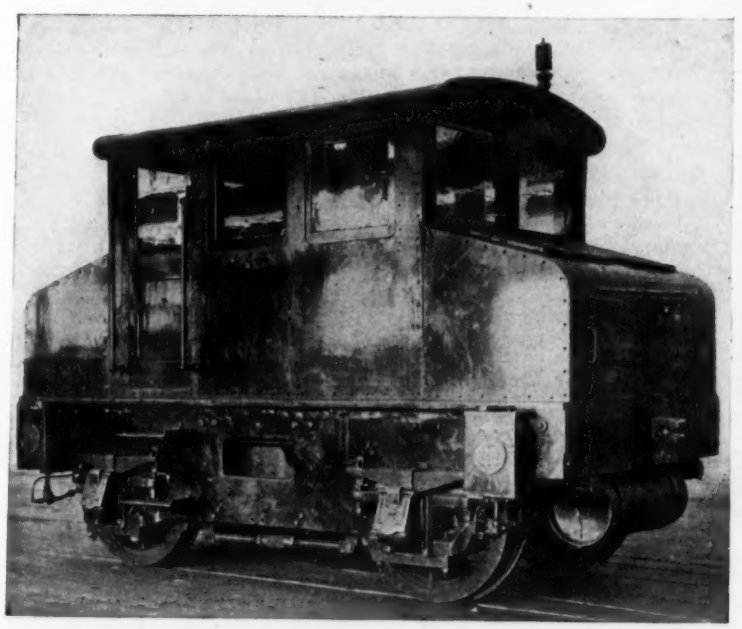
The turbine here shown has developed 30 hp with steam at 145 pounds pressure when operated non-condensing. Under these conditions the steam consumption was 32 pounds per brake horse-power per hour, and the wheel made 2,600 r.p.m. with a peripheral speed of 260 ft. per second.

Swedish Locomotive.

The accompanying illustrations show an electric locomotive equipped by the Westinghouse Electric & Manufacturing Company for the Swedish Government. One of the interesting features is the high trolley voltage for which the equipment is designed, 18,000 volts, though connections are supplied for operating at several voltages lower than this, the minimum being 3,000 volts. This high voltage necessitates the use of an oil-cooled main auto-transformer and an oil-break circuit-breaker. The intention is to operate at a moderate voltage in towns and thickly populated districts, while a high trolley the line. For this class of service, the oil-insulated, self-cooling transformer has been found especially adapted, the design being such that the excess of weight due to the oil is to a large extent counterbalanced by the reduction of weight when oil is used as a cooling medium.

The control system is electro-pneumatic and consists of an air compressor driven by a single-phase motor, an air motor on the induction regulator, air cylinders on the circuit-breaker and reverser and the necessary magnet valves. The air brakes and air sanders are also to be supplied by the above compressor. There are two connectors at each end of the locomotive, so that two locomotives can be coupled together and operated by one master switch. The master switch is in the middle of the cab, and is so situated that the operator has a clear view in all directions without leaving his seat.

The weight of the locomotive and equipment is 25 tons, all of which is on four 41-in drive wheels. Two 150-hp, 25-cycle, single-phase motors are geared, one to each axle, with a gear reduction of 18 to 70, and have shown an ability to handle a 70-ton train at 40 miles per hour, without exceeding the rise of temperature for which they were designed.



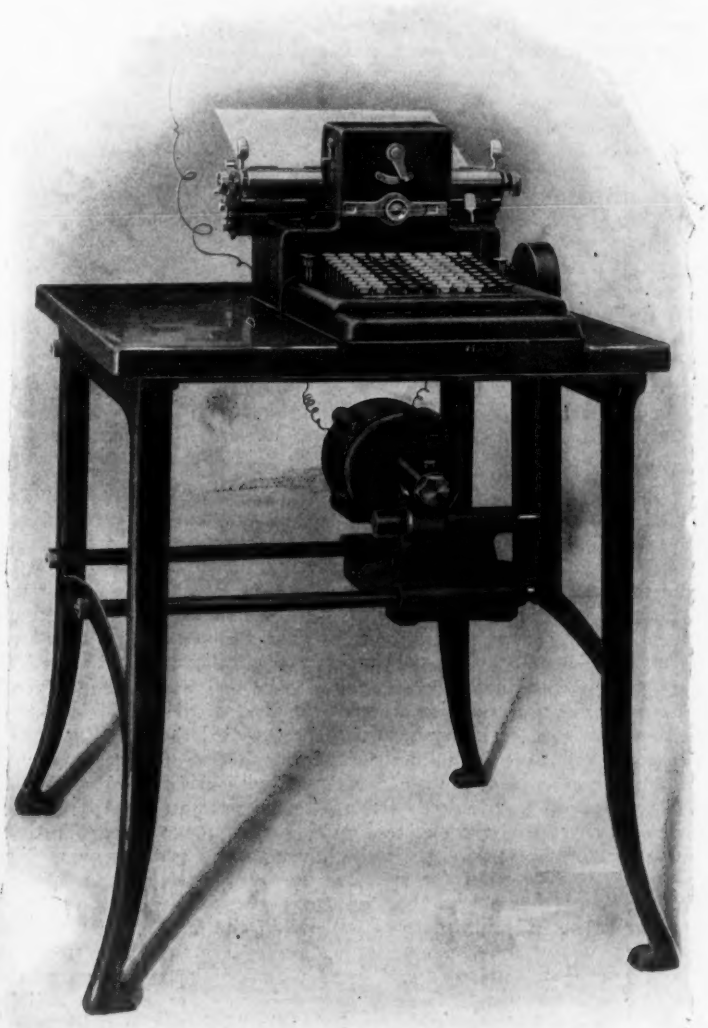
SWEDISH LOCOMOTIVE.

The equipment has been so installed on the locomotive as to permit ready access to all parts. Only the small operating devices have been placed in the cab, and the layout is such as to allow of the greatest convenience in operation with a maximum of safety to the operator.

Electric Adding Machine.

The adaptability of electric power for small isolated services is coming more and more to be recognized by business men in their every-day lives. As an example of the present-day tendency toward the adoption of electric motors for special purposes may be cited the latest development in adding machines, as indicated in the accompanying illustration. For balancing pass books, listing checks, etc., in ordinary banking transactions, for reporting sales by check, for listing sales of the different departments and for making out deposit slips and pay-rolls in mercantile establishments, the adding machine has become to be looked upon as a necessity.

Although of immense value as previously equipped for manual operation, the adding machine has been subjected to considerable improvement by the use therewith of an electric motor for doing the actual work of printing. In use the operator depresses the keys corresponding to the numbers to be printed, but instead of pulling a hand lever to make an impression on the paper he presses a button and the motor does the work. The electric starting button replaces the hand lever. Pressing the button is but the work of a moment, hence the operator has free both hands to manipulate the papers and operate the keys. The employment of the electric motor insures regular, smooth and easy action of the mechanism, a safeguard to the individual parts and a guarantee of increased life.



ADDING MACHINE READY FOR OPERATION.

The machine illustrated, which is manufactured by the Pike Adding Machine Company, at Orange, N. J., is designed to be driven by a standard electric motor of either the alternating or direct-current type. The power required is so insignificant that no special wiring is needed, and a 16-cp lamp circuit, through a flexible cord connection, serves for operating the motor.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Industrial reports are, in the main, very favorable, the unfavorable weather, however, causing retardation in some sections. Relatively the best reports come from the West, the buoyancy of advices from which is in marked contract with the same period a year ago. Estimates of the quarter's business at the leading Western markets range from 5 to 15 per cent. gain over 1904, the heaviest increase being in dry goods. Buyers are still arriving at the leading cities, placing additional spring orders, and most fall lines that have been opened are meeting with an encouraging reception. Despite occasional requests for extensions, collections are more prompt on the whole. Manufacturing returns are all that could be desired, building operations expand as the season advances, and agricultural prospects are better than normal. There is little friction between capital and labor, most new wage scales being arranged on the old basis, and in some cases advances are granted, while the number of unemployed is steadily decreasing. A general increase of wages at the plants of the greatest iron and steel producr is another tangible evidence of the improvement in that industry. New orders are coming forward constantly, and it is probable that the tonnage of advance business on the books now surpasses all previous high-water marks. Finished products are eagerly bought and high premiums are paid, but there is apparently an easier tone to crude pig, and sellers are more disposed to book ahead into the third and fourth quarters at prevailing prices. Gross railway earnings for March indicate a gain of 10 per cent. over a year ago. The gross returns for the quarter will show a moderate gain over last year. The number of business failure during the week ending April 6, as reported by *Bradstreet's*, numbered 170, against 227 the previous week, and 201 in the corresponding week last year. The number for the first quarter of the year was about 3 per cent. greater than that of the corresponding quarter of last year, but the liabilities are 38 per cent. smaller, and, with the exception of the first quarter of 1903, the lightest since 1888. The copper market was very quiet, and the closing quotations are a little lower. Lake is quoted at 15 to 15¼c.; electrolytic, 14⅞ to 15⅛c.; casting stock, 14½ to 14¾c.

STEAM PLANT FOR TONOPAH.—The equipment and construction of the entire electric transmission system for the Tonopah Mining Company was covered by one contract just awarded to Charles C. Moore & Company, of San Francisco. Current will be transmitted about 15 miles to Tonopah, Nev., at 22,000 volts for use in mining work and lighting. A 1,500-ton smelter will be operated by the Tonopah Mining Company. Coal, obtained from a new coal mine, to be developed by the company at Coalfield, will be used as fuel at the electric power plant that is to be installed at the "Wells," where large springs furnish water. The cost of the new installation is about $220,000. The equipment to be supplied through Charles C. Moore & Company includes three McIntosh & Seymour compound condensing engines of the horizontal type with gridiron valves; three Westinghouse 250-kw, three-phase 25-cycle generators, to be direct-connected to the above engines, making 150 r.p.m.; three Westinghouse exciter dynamos, six Westinghouse 300-kw transformers, three of which will be used for stepping up from 2,200 to 22,000 volts, the remaining three being the step down transformers; a number of Westinghouse induction motors for use in the mines, four Babcock & Wilcox water tube boilers, with superheaters supplying steam at about 150 pounds pressure and fitted with Wilkinson stokers of the inclined grate type and Green's economizers. The engines will be fitted with speed changers operated electrically from the switchboard for operating the generators in parallel. Time-delay dashpots are used. Three buildings are included in the contract—a brick substation at Tonopah, brick transformer houses adjoining the plant and a wooden-frame power station. Copper wire is specified for the 15-mile pole line. The condensing equipment is designed to use a comparatively small amount of water. The requirements for the condensing plant are high, based upon circulating water at 60 degrees. Within 1½ pounds of absolute vacuum is guaranteed. The machinery is to be delivered in about three months.

MORE EQUIPMENT FOR SAN ILDEFONSO.—The San Ildefonso Hydro-Electric Power Company which operates a 3,200-hp hydraulic plant on the Monte Alba River, near Mexico City, has decided to more than double its capacity. Two additional plants will be built on the same river. They will operate under heads of 350 feet and 150 feet, respectively. The combined capacity of the new power stations will be 4,000 hp. The San Ildefonso Company was organized about four years ago with a capital of $3,250,000 (Mexican currency). For the first time since operation a dividend has just been declared on the $1,000,000 worth of common stock at the rate of 6 per cent. per annum. The preferred stock, $3,250,000, has been drawing regular dividends of 7 per cent. Mr. J. D. Casasus is president of the company. Mr. Emilo Pimson is the general manager.

ELECTRIC RAILWAYS IN CHINA.—A Washington despatch states that Chas. H. Baker, of Seattle, will sail for China in May to engage in railroad building in that empire. Mr. Baker is backed by very prominent capitalists in New York and in the West and will build a trans-China electric railway system. The system is to be built in relays, and after the method of the suburban system prevailing with the third-rail lines in New York and California. The men behind Mr. Baker are all Americans, and propose a line in conjunction with Chinese capital, to be owned exclusively by American and Chinese promoters, in competition with the English syndicates operating through China now under old English concessions.

WIRELESS TELEGRAPH PROPOSALS.—Proposals will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until April 25, for furnishing and installing complete outfits of wireless telegraph apparatus and fittings at stations to be erected by the Government, as follows: One outfit each on or near the United States lighthouse reservation at Cape Henlopen, Del.; at or near Beaufort, N. C.; in the nevy yard, Charleston, S. C.; on or near the United States lighthouse reservation at St. Augustine, Fla., and Jupiter Inlet, Fla., and in the naval station, New Orleans, La. Blank proposals will be furnished upon application to the navy pay office, New York, or to the bureau.

RAILWAY EQUIPMENT.—The Cleveland Electric Railway Company is planning to increase the size of its viaduct power station, which takes care of thedowntown and west side sections of the city. A contract has been placed with the Westinghouse Electric & Manufacturing Company for a 1,500-kw direct-current railway generator to be connected to an Allis-Chalmers vertical engine. Boilers, condensers and auxiliary equipment have not yet been ordered. An extension is being built at the west end of the power station building and will provide for two units of this size, and it is probable that another similar unit will be ordered later this year.

THE SOUTHERN ELECTRIC & MANUFACTURING COMPANY, which was recently incorporated in Delaware, and has its main offices in Anniston, Ala., will manufacture electrical supplies and specialties, fixtures, fans, etc. It proposes to erect new factory buildings and will let the contracts for the same in a few weeks. The shops will be equipped with new and modern machinery, including motors and a direct-current dynamo of about 30-kw capacity. W. L. Goodhart is secretary and manager.

WESTINGHOUSE CAR EQUIPMENTS.—The South Side Elevated Railway Company, of Chicago, has contracted with the Westinghouse Electric & Manufacturing Company for complete equipments for seventy cars, which includes one hundred and forty 75-hp motors, and multiple control apparatus. The motors are of special design, and are in line with the re-equipment of this system. The cars will be operated in trains of five, three of which will be motor cars.

ELECTRIC STORAGE BATTERY.—A report of business presented at the meeting of the Electric Storage Battery Company showed that the business booked for the first current quarter of the fiscal year was four times larger in volume than that of the corresponding quarter a year ago. The company has just closed a large contract for storage batteries with the Northwestern Elevated Railroad of Chicago. It has also obtained an important contract from the Toronto Street Railway on favorable price terms. A large part of the order will be filled at the Electric Storage Battery Company's plant, at Manchester, England, so as to secure the proper central tariff accorded by Canada to imports into the Dominion from the United Kingdom.

COPPER PRODUCTION.—A despatch from Houghton, Mich., says the month recently ended was the first in the history of that district to record an output of 19,000,000 pounds of refined copper, this despite the fact that production was slightly interfered with at some of the mines owing to labor disputes.

TROLLEY WIRE FOR JAPAN.—The Elmer P. Morris Company, New York City, has secured a large contract for trolley wire to be exported to Japan.

EXPORTS OF IRON AND STEEL MANUFACTURES from the United States in the first eight months of the present fiscal year exceed those in the corresponding months of any earlier year, being $85,500,000 in value, as compared with $81,500,000, the high record made in the first eight months of the fiscal year 1901. A statement just issued by the Department of Commerce and Labor, through its Bureau of Statistics, compares the imports and exports of iron and steel manufactures during the first eight months of each fiscal year from 1885 to 1905. In 1885 exports of iron and steel manufactures during the first eight months were less than half the value of imports of iron and steel manufactures, being $11,500,000, as against $23,000,000 of imports. In 1905, during the same months, the exports of iron and steel are about six times as much as the imports of iron and steel, being $85,500,000, as against $14,000,000 of imports. Thus the balance of trade in iron and steel, which in 1885 showed a total of $12,000,000 in favor of imports, shows in 1905 to date a total of $71,000,000 in favor of exports. Machinery, the leading item of export in the iron and steel schedule, has increased from $5,487,640 in the first eight months of 1885 to $39,066,052 in the corresponding months of the present fiscal year. Under the head of machinery is included locomotives, in which the growth was from $655,096 in 1885 to $1,946,420 in 1905; printing presses, from $116,142 to $874,139; sewing machines, from $1,948,491 to $3,809,694; and, in addition, many other articles which were not enumerated in 1885, such as cash registers, electrical machinery, laundry-working machinery, typewriters, and other items representing lines of industry which have only developed in recent years. Steel rails have also increased in exports from $177,465 in the first eight months of 1885 to $8,000,649 in 1905 to date, and over half of the latter value represents shipments to the rapidly developing sections of Canada, while Japan almost equals Europe as a market for American rails, being credited with $431,304 worth as against $529,839 for Europe as a whole. Locks, hinges and other builders' hardware increased from $1,487,313 in 1885 to $7,103,845 in 1905, though the latter sum is slightly less than the totals for the corresponding periods of 1903 and 1904, the comparisons in each case being for the first eight months of the fiscal years named.

COLORADO HYDRO-ELECTRIC PLANT.—The Animas Canal, Reservoir, Water, Power & Investment Company, of Durango, Col., is now inctalling a hydro-electric plant of considerable importance. The power house is located about 20 miles from Durango, at a point affording an effective head of 970 ft. available through 2,800 ft. of pipe. The initial installation will consist of two 2,250-kw General Electric generators, direct-connected to Pelton water wheels, but provision has been made in the dam and head-works for an ultimate development of 30,000 horse power. The present pipe line, one for the two units, is of sheet steel, varying in diameter from 44 in. at the upper end to 34 in. at the wheels, and of thicknesses from 3/16-in. to 11/16-in. The pipe is all double buttstrap riveted, with triple riveting at the lower end, and is provided with flanged connections. The water wheel units, two in number, are of the "double-overhung" construction; each unit consisting of two Pelton wheels, one overhanging each end of the main shaft, with the engine-type generator in the center. Needle nozzles are used which, operated by oil-pressure, automatic governors, will insure accurate regulation and economy of water at all stages of load. The wheels are approximately 8 ft. in diameter, with centers of cast steel, turned all over and fitted with Pelton buckets straddling the periphery and secured to same by means of turned steel bolts driven in reamed holes. The buckets are fine ground and machined inside to obtain the highest possible efficiency. Each wheel unit will have a maximum capacity of 4,000 horse power to provide for an overload on the generator. The complete hydraulic plant, including pipeline and water wheels, was manufactured by the Pelton Water Wheel Company, of San Francisco and New York, and the electrical equipment by the General Electric Company, Mr. F. O. Blackwell, of 49 Wall Street, New York, being retained as consulting engineer for the company.

RECENT ALLIS-CHALMERS ORDERS.—Among recent orders received by the Allis-Chalmers Company are the following: Swift & Co., for its plant at Ft. Worth, Texas, one 600-kw, revolving field, 60-cycle, three-phase, 240-volt, 120 r.p.m. Bullock generator for supplying both light and power; Bethlehem Steel Company, a second 500-kw generator, direct connected to a Reynolds-Corliss non-condensing engine; Mineral Point Zinc Company, Chicago, a complete power equipment for its remodeled plant at Depue, Ill., consisting of two cross-compound, Reynolds-Corliss engines direct-connected to two 500-kw Bullock generators, together with a 100-kw generator and 24 motors ranging in size from 10 to 75 hp, with starters, rheostats, etc.; Mandell Brothers, for their store building on Wabash Avenue, Chicago, three 400-kw, one 200-kw and one 100-kw, direct-connected generating units; American Chiclet Company, Wabash Avenue, Chicago, a Reynolds-Corliss 10x24-inch non-condensing engine of the Reliance type; Thomas Moulding Company, Chicago, for its new brick manufactory at New Straitsville, Ohio, a 22x24-inch Reynolds-Corliss horizontal non-condensing engine, with horizontal tubular boiler, open heater and duplex feed pump; Fred W. Wolf & Co., Chicago, manufacturers of the ammonia absorption machines, two 24x42-inch heavy duty Reynolds-Corliss engines, one for installation at the refrigerating plant of the Schoen Brewing Company in Chicago, and the other at the Spreckles Sugar Refinery in San Francisco.

THE ROBB-MUMFORD BOILER COMPANY, of Amherst, N. S., has purchased the Charles River Iron Works, owned by Edward Kendall & Sons, of Cambridgeport, Mass., and will erect a new plant before the close of the present year at South Framingham, Mass. Office quarters and a main shop 150 ft. by 300 ft. are now being built on the line of the Boston & Albany Railroad, about a half-mile west of the South Framingham station. The officers of the company will be: President, D. W. Robb; secretary and treasurer, G. W. Cole; general manager, Frederick H. Keyes, and superintendent, J. W. Wilde. Mr. F. H. Keyes, the general manager, is well known in Boston engineering circles, having been an instructor at M. I. T., an engineer with Stone & Webster, and lately representative of the Robb Company in New England, with headquarters in Boston. The Kendalls will retire from business, and the new company will continue the manufacture of tubular boilers, in addition making a specialty of the Robb-Mumford internally fired boiler.

EXPORT TRADE WITH CUBA.—Exports from the United States to Cuba in the eight months ending with February, 1905, amount to $24,126,687, and are larger than in the corresponding period of any fiscal year in the history of our trade with Cuba. Compared with the corresponding period of last year they show an increase of over 42 per cent, while the imports from Cuba in the same time show an increase of only 16 per cent. The statement of trade with Cuba during the eight months ending with February, just issued by the Department of Commerce and Labor through its Bureau of Statistics, shows an especially rapid growth in exports to that island, and that the increase occurs in practically all articles entering into that trade. The exports of electrical machinery increased from $26,623 in 1904 to $35,502 in 1905.

WESTINGHOUSE TURBINES FOR JAPAN.—The Japanese engineering and contracting firm of Takata & Co., Tokio, has just placed an order, through its New York office for a fourth 1,000-kw Westinghouse steam turbine outfit. This outfit is for the new power house of the Tokio Electric Light Company, Tokio, Japan. Takata & Co. have recently shipped out the first two of these machines, and the remaining two will be shipped out some time within the next four to five months. The generators are wound for three-phase, 50-cycle, 3,500 volts. They operate at 1,500 r.p.m. The stationary armature is wound for 3,500 volts between line wires and about 2,000 volts between line wire and neutral. This neutral is brought out for operating a three-phase, four-wire lighting system.

WARD LEONARD CONTROLLERS.—The Ward Leonard Electric Company, Bronxville, N. Y., reports increasing orders for its machine-tool controllers and its United States Government type motor-controlling panels. A recent order of particular interest is one for 27 ammunition hoist controlling panels. This order was placed with the Leonard Company by the B. F. Sturtevant Company, Boston, Mass. These panels are built to conform to specifications of the United States Government. The company reports that it has been working night squads for the last three weeks in order to catch up with the large orders which it has on hand.

NEW JAPANESE TARIFF.—According to new Japanese tariff, which goes into effect July 1, 1905, the duty on electrical apparatus and material will be increased as follows: Electric light apparatus, instruments and parts thereof, from 10 per cent to 15 per cent; telephones and parts thereof, from 10 to 15 per cent; copper wire, from 10 to 15 per cent; submarine and underground telegraph cables, from 10 to 20 per cent.

POWER STATION EQUIPMENT FOR SALE.—John A. Stewart, of Cincinnati, has purchased the equipment of the Louisiana Street power station of the Indianapolis Traction & Terminal Company, Indianapolis, Ind., consisting of 1,000 hp of Wheelock engines. These are being offered for sale, as they must be moved at once to make way for improvements.

GENERAL ELECTRIC-WESTINGHOUSE RELATIONS.—A despatch from Pittsfield, Mass., to the New York daily papers reported a rumor to the effect that the working agreement said to exist between the General Electric and Westinghouse companies as to business harmony is about to be terminated. There has been no confirmation of the rumor.

WILLIAMSBURG BRIDGE PLANT.—Bids will be received April 20 by Geo. E. Best, Commissioner of Bridges, for the construction and equipment of an electric lighting station, Tompkins Street and Delancey Slip, Borough of Manhattan, New York City, for the Williamsburg Bridge.

ARMINGTON & SIMS ENGINES.—The Marine Engine & Machine Company has purchased all drawings, patterns, etc., of the later types of the well-known Armington & Sims high, medium and slow-speed engines, as improved and built during the last ten years. Mr. Gardiner C. Sims, under whose personal direction and supervision Armington & Sims engines were designed and have been built, has acquired an interest in the business and become its general manager. The Armington & Sims engines will be built in sizes ranging from 10 to 3,000 hp, and in types horizontal and vertical, side and center crank, single and in pairs, simple and non-condensing, high, medium and slow speeds, with single and Corliss valves, and adapted to direct-connected, belted or other power transmitting requirements. With modern and roomy machine shops and foundries, both amply equipped with all necessary special tools and appliances for doing large and accurate work rapidly, the company is in a position to make prompt deliveries of any of the sizes and types of engines. Upwards of 6,600 Armington & Sims engines have been built and sold in all parts of the world, a record perhaps without equal.

COMBINATION MOTOR CAR.—The General Electric Company will deliver to the New York Transportation Company the first of a new type of motor passenger car which the Transportation Company will operate on its Fifth Avenue line. The new car differs widely from the electric carriage, which the company now operates, its motive power being a combination of gasoline and electricity. The entire control of the new car centers in a small push button, and this feature will eliminate the need of an expert operator. General Electric officials, it is stated, are confident that the car will prove a success, and an agreement has been entered into between the two companies, which is substantially that the General Electric Company will meet all expenses incurred if the car does not prove a success. One of the features is that the car can be operated for an entire day without danger of exhausting its motive power. It is stated that the cost of operation will be about one-half the cost of operating the electric car.

ALLIS-CHALMERS PLANT EXTENSIONS.—It is announced that the Allis-Chalmers Company has decided upon extensive additions to its plant at West Allis, Milwaukee. Plans are being completed for the erection of three large buildings and the extension of two others. The new buildings will provide accommodations for the manufacture on a large scale of steam and hydraulic turbines, gas engines and electrical machinery of all kinds and of the largest type. The electrical department will be operated in connection with the extensive plant of the Bullock Electric Manufacturing Company at Cincinnati, owned by the Allis-Chalmers Company. It is expected the improvements contemplated, with full equipment, will cost approximately $3,000,000.

TURBO-GENERATORS.—Orders recently placed by the Philadelphia Rapid Transit Company and the United Electric Light Company, of Springfield, Mass., are evidence that steam turbines and turbine generators are all that is claimed for them by the manufacturers. Both of these companies have been operating Westinghouse-Parsons units of this type, and as soon as they can be built the former will install two 1,500-kw, 13,200-volt, turbine-driven generators, and the latter company a 1,000-kw unit of the same type.

WESTINGHOUSE RAILWAY APPARATUS.—The Transit Development Company, of Brooklyn, has placed an order for 204 Westinghouse No. 101-B railway motors. The Westinghouse Company has received from other companies several smaller orders for the same motor, and also for their No. 93-A. The University of Illinois has received a quadruple equipment of these motors with two sets of unit switch control for practical demonstration of the system.

TURBO-GENERATOR ORDERS.—Orders for eight turbo-generators have been placed with the Westinghouse Electric & Manufacturing Company in the past week, mostly 400 and 500 kw units, with one of 200 kw and one of 2,500 kw.

Financial Intelligence.

THE WEEK IN WALL STREET.—There was considerable activity in the New York stock market. Among the features were United States Steel securities, the preferred stock selling up to 103, which is the highest price it has ever touched. The bonds also made a new high record and the common stock was exceedingly strong, the whole movement being apparently based upon the very favorable reports about the present earnings of the corporation and the large quantity of orders booked and in sight. The industrial list also showed strength. At the close of the week the market showed some irregularity. There were no features in the electrical securities market, although General Electric and Westinghouse developed considerable strength and closed with substantial gains, the former at 188½, being a net advance of 3 points, and the latter at 181½, a gain of 2 points. Allis-Chalmers common gained ⅛-point, closing at 17½, but preferred stock was weak and lost 1 point, the closing quotation being 61. Among the railway securities Brooklyn Rapid Transit showed considerable activity, the sales aggregating 186,700 shares, at prices ranging between 66⅞ and 70½, the closing quotation being 67⅞, a net gain of 2¾ points. Metropolitan Street Railway closed at 122¾, and is practically unchanged. Interborough Rapid Transit made a net gain of 2 points, the range of prices being between 206 and 213, closing at 209. American Telephone & Telegraph made a gain of ½ point, closing at 145; New York & New Jersey Telephone closed at 170, which is a fractional advance, and Western Union is up a fraction, closing at 93⅜. American District Telegraph is off 5 points, closing at 33. Electric Storage Battery lost 1⅞ points net on the week's business, and closed at 87. Following are the closing quotations of April 11:

NEW YORK

	Apr. 4	Apr. 11		Apr. 4	Apr. 11
Allis-Chalmers Co.	16¾	16¾	Electric Vehicle pfd.	21	21
Allis-Chalmers Co. pfd.	60⅜	60⅛	General Electric	187	184½
American Tel. & Cable.	90	91	Hudson River Tel.	..	..
American Tel. & Tel.	144	144	Interborough Rap. Tran.	212⅜	207
American Dist. Tel.	32	32	Metropolitan St. Ry.	122⅞	122
Brooklyn Rapid Transit.	67⅛	69¾	N. Y. & N. J. Tel.	..	172
Commercial Cable	..	..	Marconi Tel.	..	..
Electric Boat	37	38	Western Union Tel.	92⅝	93⅜
Electric Boat pfd.	75	75	Westinghouse com.	180	177
Electric Lead Reduction	¼	..	Westinghouse pfd.	189½	196⅞
Electric Vehicle	12	12			

BOSTON

	Apr. 4	Apr. 11		Apr. 4	Apr. 11
American Tel. & Tel.	144⅞	144	Western Tel. & Tel. pfd.	*101	*101½
Cumberland Telephone.	119½	119¼	Mexican Telephone.	1¼	1¼
Edison Elec. Illum.	255	256	New England Telephone.	136	139½
General Electric.	186½	185	Mass. Elec. Ry.	21¾	21½
Western Tel. & Tel.	*20	*20	Mass. Elec. Ry. pfd.	69	68½

PHILADELPHIA

	Apr. 4	Apr. 11		Apr. 4	Apr. 11
American Railways.	54	54	Phila. Traction.	..	100
Elec. Storage Battery.	88⅞	84	Phila. Electric.	11⅜	11¼
Elec. Storage Battery pfd.	..	..	Phila. Rapid Trans.	31¼	31⅛
Elec. Co. of America.	12⅛	12			

CHICAGO

	Apr. 4	Apr. 11		Apr. 4	Apr. 11
Central Union Tel.	†	.	National Carbon pfd.	†	114
Chicago Edison.	†	..	Metropolitan Elev. com.	†	22⅛
Chicago City Ry.	†	..	Union Traction.	†	10
Chicago Tel. Co.	†	..	Union Traction pfd.	†	34
National Carbon.	†	53			

* Asked. † Holiday on account of Election.

NEBRASKA BELL TELEPHONE.—The following is the report of the Nebraska Bell Telephone Company:

	1904.	1903.
Gross	$1,666,415	$1,049,907
Net	259,980	192,596
Dividends, 6 per cent.	134,229	115,768
Surplus	125,751	76,828

CALIFORNIA GAS & ELECTRIC.—The following is a comparative statement of earnings of the California Gas & Electric Corporation for the months of February, 1904, and February, 1905:

	1904.	1905.	Increase.
Gross earnings	$273,465.94	$395,786.06	$122,320.12
Operation, maintenance, taxes, insurance and bond interest of subsidiary companies	186,075.81	290,910.03	104,834.22
Profit	$87,390.13	$104,876.03	$17,485.00
Corporation bond interest	33,333.33	36,600.00	3,266.67
Balance	$54,056.80	$68,276.03	$14,219.23
Sinking Fund	12,500.00	12,500.00	.....
Net surplus	$41,556.80	$55,776.03	$14,219.23

NEW ORLEANS RAILWAYS.—At the annual meeting of the New Orleans Railways Company, held in Jersey City, 99.1 per cent. of the $27,588,900 common stock outstanding, 98.9 per cent. of the $17,809,000 bonds, and 98.8 per cent. of the $8,792,400 of preferred stock assented to the reorganization of the company. The following directors were re-elected: J. B. Levert, A. Brittin, A. Baldwin, Henry T. Bart, John G. Gannon, Charles F. Fairchild, Joseph E. De Grange, W. R. Stauffer, Maurice Stern, Hugh McCroskey, Sylvester T. Walmsley, Henry E. Ahern, A. Murray Young, Victor Leevy and W. E. Stuffer. This concern is in the hands of Receiver E. C. Foster, of New Orleans, who was formerly president of the company. The company will be reorganized.

MASSACHUSETTS ELECTRIC.—The $500,000 additional stock authorized the Old Colony Street Railway Company by the railroad commissioners is to be used for the following purposes: $425,000 for the payment of existing indebtedness incurred in making certain improvements and additions to the railway property, and $75,000 for payment of necessary cost of additions and improvements to property. The $500,000 authorized the Boston & Northern Street Railway Company will be used for the following purposes: $400,000 for paying existing indebtedness and making improvements to property, and $100,000 for proposed additions and improvements to the property.

BROOKLYN RAPID TRANSIT BONDS.—Brooklyn Rapid Transit has applied to the New York Stock Exchange to list $1,750,000 additional refunding mortgage 4 per cent. bonds of 2002.

DIVIDENDS.—The directors of the United Traction Company, of Albany and Troy, have declared the regular quarterly dividend of 1¼ per cent.

General News of the Week

The Telephone.

ATHENS, ALA.—The Athens Telephone System has been sold to the Bell Telephone & Telegraph Company.

PRESCOTT, ARIZ.—A deal has been closed whereby the Prescott Electric Company and the Consolidated Telephone, Telegraph & Electric Company, of Tucson, have consolidated in northern Arizona, and all lines north of Maricopa County are to be controlled by the Prescott Electric Company. Offices of the Consolidated or Sunset Company are to be closed in this county, and the connections transferred to the electric offices. The service is to be improved. Connections are now being made between Tucson and Los Angeles.

HOT SPRINGS, ARK.—At the annual meeting of the stockholders of the Southern Telephone Company, C. N. Rix was elected president; Jas. R. Brailey, Jr., vice-president; C. F. Cooley, secretary, and Hon. H. L. Vouti, treasurer.

DOWNEY, CAL.—The Home Telephone Company's new long-distance line between Downey and Los Angeles has been opened for business.

WILLOWS, CAL.—Plans are being made by local capitalists to build a telephone line from Elk Creek, in Glenn County, to Round Valley in Mendocino.

BISHOP, CAL.—An ordinance has been passed granting M. A. George and others a franchise and right of way for a telegraph and telephone system in the town of Bishop.

LOS ANGELES, CAL.—The Sunset Telephone & Telegraph Company has begun improvements to its system, which will cost $40,000. It will construct seven blocks of underground system and will add several miles to its aerial line.

LOS ANGELES, CAL.—The Board of Directors of the Redondo Home Telephone Company will hold a meeting, May 29, to take into consideration the proposition of creating a new bonded indebtedness of $30,000. C. P. Platt is president.

SAN FRANCISCO, CAL.—J. S. Torrance and Thomas W. Phillips, directors of the Home Telephone Company, of Los Angeles, have visited in San Francisco in the interests of a proposition to install their automatic telephone system in San Francisco. Attorneys Thomas, Gerstle and Frick are preparing a franchise ordinance to be submitted to the Supervisors. It is alleged that much San Francisco, as well as Los Angeles, capital has been secured. It is said that Mark L. Gerstle and his friends can supply a goodly portion of the $6,000,000 which may be needed to thoroughly cover the city. President John I. Sabin and other officials of the Pacific States Telephone & Telegraph Company, which has a practical monopoly of the telephone business in this city at present, say they will fight any competing concern with energy. The Pacinc States local system is to be thoroughly remodeled this year, the central system being installed. New switchboards will be constructed at great expense for the new 7-story central office building now in course of construction on Bush Street, near Grant Avenue. New executive offices are being constructed.

METAMORA, ILL.—The local telephone company has sold out to Mr. Peter Sommers, of Washburn.

MARISSA, ILL.—The Marissa Farmers' & Merchants' Telephone Company has been incorporated, with a capital stock of $10,000, by G. W. Nevin, S. S. Boyle and W. E. Meek.

PEORIA, ILL.—The Central Illinois Independent Telephone Association has adopted a uniform toll rate for long distance calls by the independent companies from 25 to 50 per cent. lower than at present.

BELVIDERE, ILL.—The Farmers' Telephone Company, of De Kalb County, will build a line to Cherry Valley, where it will be connected with the Rockford-Belvidere line and give service over the systems of both companies.

PEORIA, ILL.—A co-operative telephone company has been formed in La Prairie, Lawn Ridge, Hallock and the neighboring country. The City Council of Chillicothe will be asked to permit the entrance of the lines into that city.

CHICAGO, ILL.—A trust deed for the sum of $2,000,000 has been filed in this city by the Larimer Automatic Telephone Company, organized under the laws of Maine, to the Federal Trust & Savings Bank Company, of Chicago. The signers to the document are A. M. Johnston, president of the Larimer Automatic Telephone Company, and Irving J. Shuare, secretary of the trust company.

PEORIA, ILL.—With the view of organizing one of the largest independent telephone associations in the West, a meeting attended by over 100 representatives of independent companies of Illinois has been held in this city. One of the principal objects of the organization is to form uniform toll rates which shall obtain through the district. A committee composed of E. R. Conklin, of Peoria, and J. W. Barrett, of Pekin, was appointed to draw up the schedule and report at a future meeting of the association. It was announced that reductions of from 25 to 100 per cent. from the toll rates charged by the Bell Company will be current when the long-distance lines now being projected are finished. These lines will reach nearly 100,000 telephones. The toll lines will connect with the Kinloch system at St. Louis, thereby gaining connection with Missouri. Officers were elected as follows: President, C. H. Glass, Pekin; vice-president, C. A. Camp, Henry; secretary, A. Schuler, Streator; treasurer, B. F. Wasson, Clinton; executive committee, L. C. Schwerdtfeger, of Lincoln, and O. C. White, of Princeton.

DELPHI, IND.—The Brighthurst Co-operative Telephone Company has been incorporated. W. J. Nimmins is president and C. Retherford, secretary.

WABASH, IND.—The consolidation of the Farmers' Mutual Telephone Company and the Home Telephone Company, of Whitley County, has been effected, and the Farmers' Company will increase its capital stock and expand its business.

BIRDSEYE, IND.—The Farmers' Telephone Company, of Birdseye, has been formed; capital stock, $110. Directors: George T. Veach, Joseph E. Harmon, W. H. Sinclair, Thomas Nelson and John W. Adkins.

GREENSBURG, IND.—The Central Union Telephone Company has recently closed contracts with the independent plants at St. Paul, Batesville, Milan, Dillsborough, Moores Hill, Osgood and Versailles whereby it secures exclusive long-distance service through those plants. These contracts give the company almost entire control over the long-distance service in Ripley County.

COUNCIL BLUFFS, IA.—The city has voted to grant a franchise for an independent telephone exchange.

GREENFIELD, IA.—The Western Farmers' Mutual Telephone Company has been organized in this city.

NEW LONDON, IA.—The Henry County Telephone Company will increase its capital from $15,000 to $30,000 and make improvements.

OAKSVILLE, IA.—The Oakville Telephone Company has been sold to Charles Avery, of North Branch, Minn., who will make improvements.

ALTA VISTA, IA.—The Alta Vista Farmers' Telephone Company has been formed with $2,500 capital stock. The incorporators are C. F. Smith, Charles Joachim, Fred Rabe and others.

COUNCIL BLUFFS, IA.—The Independent Telephone franchise has been signed, and the company is now ready for business. Already many independent companies are asking for connection with the company here.

LILLY, IA.—A telephone company has been incorporated in the Lilly Lounsbury line in Day County, with headquarters in Lilly, and a capital of $1,000. Incorporated by A. M. Walsrigm, M. S. Peterson and others, of Lilly.

DES MOINES, IA.—Des Moines men are largely interested in the Iowa Telephone Company now, and three local men were selected as directors at the annual meeting. N. T. Guernsey, P. J. Mills and B. F. Kauffman were elected directors. C. E. Yost, of Omaha, was elected president of the company, and E. B. Smith, of Des Moines, vice-president and general manager. James B. Mason, of Des Moines, is secretary, and Emil Palm, auditor. The directors elected at the annual meeting follow: Frederick P. Fish, of Boston; F. H. Griggs, of Davenport; E. E. Cook, of Davenport; C. E. Yost, of Omaha, Neb.; N. T. Guernsey, P. J. Mills, B. F. Kauffman and E. B. Smith, of Des Moines.

ASHLAND, KY.—It is announced that the independent exchanges at Ashland and Catletsburg, Ky., have been merged with the Bell.

MANCHESTER, KY.—W. W. Rawlings and White & Walker, of Manchester; Judge H. C. Faulkner, of Barbourville, and others, have organized a company to extend the lines from Burning Springs to Booneville, Owsley County, thence to Beattyville; also a line from Booneville to Telega and Heidelberg. An exchange will be established at Booneville. These lines will connect at London with Lancaster and Lexington lines, and to southeastern Kentucky. Work will begin at once.

LANCASTER, KY.—A. H. Bastin, of the Bastin Telephone Company, of Lancaster; the Fayette Home Telephone Company, of Lexington, and John Woodward, Camp Ground Telephone Company, and the lessee of London and Manchester lines, have entered an agreement to build a first-class copper circuit from Lexington to Jellico, Tenn. There are two gaps of pole line of 28 and 15 miles to be built, beside the reconstruction of a large portion of the present pole line. Active work has been begun on the Jellico division to Barbourville and on two other divisions between the latter place and Lexington, Ky. At Jellico connection will be made with the Knoxville Independent people who already have copper lines into Jellico.

LAKE CHARLES, LA.—Application for a telephone franchise for twenty years is to be made to the City Council by W. E. Niles, of Sioux Falls, S. D. This is an independent company and will compete with the Cumberland Company, now established here. In the downtown district the company represented proposes to place the wires underground, and will charge no rentals until 500 bona fide telephones are subscribed for, installed and in active operation.

OPELOUSAS, LA.—The Bertha Telephone Company has been reorganized, the Bertha Telephone and Telegraph Company being incorporated, with A. B. Pickett as president; Charles B. Chachere, vice-president; Daniel L. Baker, secretary and manager, and Paul A. Blanchard, treasurer. It is the purpose of the new company to extend its lines throughout this parish and connect with the independent lines at Lafayette, giving through connection with New Orleans and intermediate points.

LINCOLNVILLE, ME.—The Centre Lincolnville Telephone Company has voted to increase the amount of its capital stock from $15,000 to $40,000.

PORT DEPOSIT, MD.—At a meeting for the reorganizing of the Cecil Farmers' Telephone Company it was decided to amend the charter by raising the capital stock from $5000 to $25,000. Officers for the ensuing year were elected as follows: R. E. M. Clenahan, of Port Deposit, president; Elwood Balderston and E. T. Dorens, vice-presidents.

HANCOCK, MINN.—A telephone company has been formed to build a line in Lakeside. Chas. Messner is secretary.

VIRGINIA, MINN.—The Mesaba Telephone Company contemplates many improvements to its line the coming season. It is also understood that the company will transfer its range headquarters from Eveleth to this city.

REDWOOD, MINN.—At the last meeting of the board of directors of the Minnesota Central Telephone Company, $10,000 was set aside for improvements

here in the way of a new copper circuit from Redwood Falls to Sleepy Eye, for a new line to Seaforth, and for office equipment and cable work in this city. The office equipment will consist of four new sections of metallic switchboard, two of which will be used locally and the others for toll lines. The plans for the cable service provide for about 7,000 feet of cable, ranging from 25 up to 200 pair capacity.

OAK GROVE, MO.—The Laurine Telephone Company, of Oak Grove, will install an exchange at Grain Valley. It will connect Oak Grove, Long Jack, Grain Valley and Blue Springs.

BROKEN BOW, NEB.—The new co-operative company that proposes to buy out the Central Telephone system has held a meeting. J. D. Ream was elected president, M. S. Eddy, secretary and L. H. Jewett, treasurer. The co-operative companies of Milburn and Anselmo will fix a basis, with the aid of referees, on which to go into the organization.

TONOPAH, NEV.—The Bull Frog, Tonopah & Las Vegas Telephone Company has awarded a contract for the construction of a telephone line between Bull Frog and Las Vegas.

MILFORD, N. J.—A telephone company has been organized at Milford with these officers: President, A. C. Rapp; vice-president, Mahlon W. Angell; secretary, William H. Farrand; treasurer, Elmer E. Culver. Besides connecting with other places the company will build a line to Riegelsville, where it will connect with the long distance telephone.

PERTH AMBOY, N. J.—At a public hearing on the application of the Hudson & Middlesex Telephone Company for a franchise in this city, the sentiment was almost unanimously in favor of the independent company. An ordinance granting the franchise was passed last year by the Council and vetoed by the Mayor.

AUBURN, N. Y.—The Secretary of State has granted a certificate of incorporation to the Spring Lake & Westbury Telephone Company.

CATO, N. Y.—The Cato & Meridian Telephone Company has been formed by J. E. Casey, G. B. Hapeman and others, of Cato, N. Y. The capital is $20,000.

SYRACUSE, N. Y.—The Central New York Telephone and Telegraph Company has commenced work on the construction of about ten miles of underground wiring through subways, at a cost of $100,000. When this work is completed the company will have about twenty-two miles of underground work in Syracuse.

CRYSTAL SPRINGS, N. Y.—The annual meeting of the Dundee & Crystal Springs Telephone Company has been held. The following officers were elected: President, Delmar J. Knapp; vice-president, Frank VanGordon; secretary and treasurer, Lyman Disbrow.

AUBURN, N. Y.—A certificate of incorporation has been granted to the Cato & Meridian Telephone Company. The new company, which is capitalized at $25,000, will operate a line in the northern part of Cayuga County and a part of Seneca, Wayne and Onondaga Counties.

HIGHLAND MILLS, N. Y.—The annual meeting of the stockholders of the Highland Telephone Company has been held and the following officers were elected: President, Henry Greenfield; vice-president, John H. Hunter; superintendent, C. H. Tuthill; secretary, F. H. Florance; general manager, G. H. Ayers; treasurer, B. C. Durland.

GLOVERSVILLE, N. Y.—A number of citizens of Gloversville have organized a Home Telephone Company with a capitalization of $400,000. This move is due, it is said, to the purchase of the Glen Telephone Company plant by the Bell Company and the indignation of the citizens over the increase of rentals by the present Glen-Bell Company from $12 for residences and $24 for business places per year, to $24 for residences and $42.50 for business places per year. The new Home Company will give telephone service at the former rates of rental.

SARATOGA SPRINGS, N. Y.—The independent telephone exchange at Saratoga Springs has recently placed a contract for an additional section to its central office equipment which is the third spring addition to the company's system since its opening in 1902. The exchange was originally equipped with the "International" patent central energy multiple switchboard system, and the original apparatus, together with all of the extensions of the same make, are said to be giving as good service as when first installed and requiring but very little attention and practically no cost for maintenance.

LEXINGTON, N. C.—The owners of the telephone line from Lexington to Fairmont and Jackson Hill will extend the line to Denton.

COLUMBUS, OHIO.—The Telephone Working Company, of Tiffin, capital $50,000, has been incorporated by W. J. Roosem and John A. Belford.

McCONNELSVILLE, OHIO.—The Riverside Telephone Company has been incorporated with a capital stock of $25,000. The incorporators are John D. Erwin, W. A. Cosgrave, W. P. Scott, G. M. Scott and Etha P. Erwin.

EDGERTON, OHIO.—The Edgerton Telephone Company has been incorporated with a capital stock of $30,000. The incorporators are Jacob V. Zeeb, Claude E. Hoover, Walter S. Unger, James F. Reasoner, Lewis E. Groff and Emmet A. Geauque.

COLUMBUS, OHIO.—The Bell Telephone interests have gained control of all the independent telephone exchanges in Jackson County. This includes the exchanges at Jackson, Wellston, Coalton, Oak Hill and Hamden, a total of over 1800 instruments.

CLEVELAND, OHIO.—It is stated that the business of the Cuyahoga Telephone Company has been increasing so rapidly of late that the management has given orders for the immediate installation of two new sections to the switchboard, each of which will accommodate 480 drops.

TOLEDO, OHIO.—The United States Telephone Company, through which the Toledo Home Telephone Company does the greater part of its long-distance business, is stated to be negotiating with the owners of the Northwestern Toll Line Company for the sale of the property of the latter.

TOLEDO, OHIO.—About 600 girls, employed as telephone operators in the smaller towns of northwestern Ohio, were entertained here March 28 by the Home Telephone Company. The local and long distance plants were inspected and explained to the girls, who were then taken by special cars about the city and were entertained by the telephone company at a dinner in the evening.

PERRY, OKLA.—The Perry Northwestern Telephone Company, of Perry, has been incorporated with a capital of $5,000, by T. D. Wolfinger, A. B. Nichol and others.

EDDY, OKLA.—The Eddy Short Line Telephone Company, with a capital of $200, has filed articles of incorporation. The incorporators are Valzar Siebenthaler, Chas. W. McClellan, and others, all of Eddy.

KITTANNING, PA.—The Butler-Coylsville Telephone Company, of this city, has been incorporated with a capital of $5000.

SOMERSET, PA.—A new telephone company, to be known by the name of "The Economy," has been organized here by a number of local capitalists.

BEAVER, PA.—An ordinance has been presented to Council by the Bell Telephone Company to allow it to put conduits under the streets. The Bell Company has refused to pay $1 pole tax, and a motion was passed to sue the company. The company offers 50 cents a pole.

PITTSBURG, PA.—The Council of East Pittsburg Borough is after the Pittsburg & Allegheny County Telephone Company for alleged failure on the part of the latter to carry out the provisions of a rights-of-way ordinance granted a year ago last January. The company agreed to give service to the people of East Pittsburg in one year, or forfeit its rights as well as its bonds.

ALTOONA, PA.—At a meeting of the stockholders of the Morrison's Cove Telephone Company the capital stock was increased from $15,000 to $25,000. Later the board of directors authorized the establishment of central offices at Roaring Spring and Williamsburg. With the additional capital the lines will be extended and a central office will be established at Hopewell, Bedford County.

NARRAGANSETT PIER, R. I.—Two new telephone exchanges will be built this year by the Providence Telephone Company, of Narragansett Pier and North Attleboro.

PROVIDENCE, R. I.—According to the announcement made by the Providence Telephone Company the rates for extension telephones will be reduced to $6 a year to subscribers, or just one-half of the the present rate.

PALATINE, S. D.—The Palatine Telephone Company of Palatine Township has been incorporated with a capital of $24,000.

EPIPHANY, S. D.—Articles of incorporation have been filed by a rural telephone company, to be known as the Farmers' Epiphany line, with headquarters at Epiphany; capital $1750.

DALLAS, TEX.—Texas Consolidated Long Distance Telephone Company has been formed, capital stock $30,000, to build and operate a long-distance telephone system in a number of counties of North Texas. It is incorporated by G. Locke Arnold, C. L. Simpson, A. W. Stearns, F. B. McElroy and A. J. Brown, all of Dallas.

PIEDMONT, TENN.—At the meeting of the Board of Mayor and Aldermen of this city the Piedmont Telephone Company was granted a franchise to run its lines into Jefferson City. The line is already completed to the corporation limits. Dr. W. R. West, of Piedmont, is general manager and J. Brooks is secretary of the company.

SPARTA, TENN.—The annual report of the Gainesboro Telephone Company, with headquarters here, shows the growth of its lines from a few miles in 1896 to 2,200 miles of line and 25 exchanges at present. The capital stock paid in is $214,700. The operating and maintenance expenses and taxes last year were over $26,000, the gross revenue was $47,357.43, the dividends amounted to $10,093.50, and a reasonable amount was paid to the depreciation fund. The lines of this company extend through Tennessee and Kentucky.

LOGAN, UTAH.—The City Council has granted to the Utah Independent Telephone Company a 50-year franchise to operate its system in this city.

SALT LAKE, UTAH.—Supt. H. H. Hempstead, of the Utah division, Rocky Mountain Bell Telephone Company, states that a new telephone line will be constructed from Bancroft to Soda Springs, and another line will be started at Minidoka, which will follow the line of the new railroad being built by the Oregon Short Line.

CHUCKATUCK, VA.—The Chuchatuck Telephone Corporation is chartered with $5000 maximum capital. W. A. Willis, of Chuckatuck, is secretary and general manager.

TACOMA, WASH.—The Sunset Telephone & Telegraph Company proposes to build a subway system for its wires.

STURGEON BAY, WIS.—The Door County Telephone Company of this city has been formed by Henry Grass, Henry Fetzer and others, capital $15,000.

SHAWANO, WIS.—The Town Line Farmers' Independent Telephone Company has been incorporated, capital $1,000, by W. F. Wenzel, George Klebesadel and others.

HAGER, WIS.—The Hager Telephone Company has been organized at this city with Frank Way, president, and J. W. Milton, secretary. It will extend its lines through Trimbelle Valley.

RACINE, WIS.—The Citizens' Telephone Company has closed a contract with the Dean Electrical Company, of Elyria, Ohio, to furnish the latest improved equipments and a switchboard for its proposed new exchange building to be erected this summer. The new switchboard will accommodate 5000 telephones.

STRATFORD, ONT.—The Bell Telephone Company has agreed with the City Council to place its wires underground in the main business portion of the city. The company estimates the necessary expenditure to complete the work will be between $10,000 and $11,000.

Electric Light and Power.

STURDEVANT, ALA.—The Tallapoosa Water Power & Electrical Company has been incorporated with a capital of $100,000 by Fred Ausfeld and Robt. A. Chapman, of Montgomery and Mrs. Dinnie Parker, of Dadeville. The company will build a dam on Tallapoosa River at Sturdevant and will there generate electricity by water power. The principal office will be at Montgomery.

SAN LUIS OBISPO, CAL.—The San Luis Gas & Electric Company is asking for bids for the construction of an electric light plant, to cost $30,000.

HARTFORD, CONN.—The Senate has reported favorably on two resolutions amending the charter of the Hartford Electric Light Company, allowing an extension to Rocky Hill and authorizing an increase of capital to $3,000,000 and bonds to $2,000,000.

ENFIELD, CONN.—The Enfield Electric Light & Power Company is making preparations to extend its lines into Hazardville and Scitico, the necessary wires and other equipments having already been ordered. The company is arranging not only for street lighting but for houses and places of business in that section.

WOODBURY, CONN.—The Woodbury Electric Company has practically completed an electric lighting plant. Two dams have been erected, and a storage reservoir, covering 32 acres and having a capacity of 55,000,000 gallons of water, has been built. The power station is 22 by 24 feet, and the fall from the distributing reservoir to the power house is 192 feet. The company has elected a new board of directors, consisting of Floyd F. Hitchcock, S. C. Tomlinson, W. L. Judson, Arthur D. Warner and E. S. Boyd. Mr. Hitchcock has been chosen president, Mr. Tomlinson, vice-president, and Mr. Boyd secretary and treasurer.

ST. AUGUSTINE, FLA.—George Old, manager of the St. Augustine Gas & Electric Company has notified the City Council that the company has determined to take advantage of its franchise to install an electric light system here and has ordered the necessary machinery and equipment.

LEWISTON, IDAHO.—Francis Jenkins, of Moscow, is interested in the construction of a power plant at Elk Creek Falls.

BOISE, IDAHO.—Articles of incorporation of the Utility Power Company, with a capitalization of $300,000, have been filed. The incorporators are J. L. Weaver, Frank Martin and L. J. Weaver, of this city, and Henry Fitch and B. A. Dare, of New York.

WEISER, IDAHO.—A company has been organized, with Pitts Ellis, president, and J. H. Morrison, secretary, to construct a plant and develop the water power on Weiser River to furnish light and power for Weiser. The probable cost of the work is placed at $40,000.

MARSEILLES, ILL.—The Marseilles water works and electric lighting systems, both of which were owned by W. D. Boyce, have been consolidated and disposed of to a new syndicate of which John M. Nicholson, of this city, is president and treasurer.

MISSOURI VALLEY, IA.—The electric light plant, heating and power plant and telephone system in this city have been sold to L. A. Little, of Buffalo Lake, Minn., for a consideration of $70,000.

KINGHAM, KAN.—W. K. Palmer, consulting engineer, 718 Dwight Building, of Kansas City, Mo., has completed plans and specifications for a modern hydro-electric power station for the Kingman Light & Power Company. The plant will be operated by means of water power derived from the Ninnesoah River and a reserve power installation in the shape of a gas engine and suction gas producer.

PORTLAND, ME.—The Cascade Light & Power Company has been incorporated with a capital of $100,000. C. A. Hight is president, Boston, Mass. L. L. Hight, secretary, of Portland.

ELLSWORTH, ME.—The much discussed and frequently postponed electrical plant will be built, according to a statement made by F. W. Ayer, of Bangor, within a few months. The capital will be furnishel by Mr. Ayer, backed by a number of business men in Portland and Boston. The plant will be located either at Ellsworth or Bradley.

HOLYOKE, MASS.—The Holyoke Water Power Company is completing plans for utilizing the surplus water of the Connecticut River. It is proposed to expend about $60,000.

WEYMOUTH, MASS.—The Weymouth Electric Light Committee has organized with A. F. Barnes, chairman; William J. Coleman, secretary; A. F. Barnes, W. J. Coleman, G. W. Baker, M. O'Dowd and R. B. Worster, notification committee

ABERDEEN, MICH.—Reid & Briggs are preparing plans for an extensive addition to the plant of the Grays Harbor Lighting Company, at East Aberdeen. E. A. Bradner, Hoquiam, is chief engineer.

TROY, MO.—The City Council has purchased a site for the municipal electric light plant.

MADISON, MO.—The citizens have voted to issue $5,000 bonds for an electric light plant.

MARSHALL, MO.—A. H. Bickmore & Co., of New York, N. Y., are reported to have purchased the electric light plant and gas plant at Marshall. The two plants will be consolidated and extensively improved.

LINDSBORG, KAN.—Bids will be received on April 20 for the construction of an electric light plant, to cost $29,000. Geo. C. Morgan, Chicago, Ill., is the engineer. A. A. Abercrombie is city clerk.

CARLISLE, KY.—A company has been organized here, with C. C. Cole, president, and Geo. A. Straus, secretary, to construct an electric light plant, at a cost of $15,000.

DODGE, NEB.—It is proposed to construct water works and an electric light plant at a cost of $10,000. Bonds will be issued in about two weeks. No engineer has been selected as yet.

FARMINGTON, N. H.—Some changes are about to be made at the electric light plant. A new 75-horse power engine is to be installed, and it is expected that a current regulator also will be put in.

HIGHLANDS, N. J.—The citizens have voted to issue $25,000 bonds for water works and an electric light plant.

SALAMANCA, N. Y.—The citizens have voted to purchase the electric light plant and water works. C. F. Buckmeister is City Clerk.

SANDY HILL, N. Y.—The United Gas, Electric Light & Fuel Company of this village has sold its interests to Dr. Wentz, of Scranton, Pa.

SYRACUSE, N. Y.—The People's Gas & Electric Company, now that it has secured a renewal of the contract with the city for the next five years, is making plans to extend its rural service.

NEWARK, N. Y.—The electric light plant of the New Light, Heat & Power Company has been sold by the Gas & Electric Development Company, of Philadelphia, to some of its Philadelphia clients.

ALBANY, N. Y.—The annual supply bill prepared by the Assembly Ways and Means Committee contains an appropriation of $52,000 for the purchase and installation of an electric light plant for the State buildings.

GLENS FALLS, N. Y.—On account of the extensive interests of the Hudson River Water Power and subsidiary companies in the central part of the state the principal business office of the companies will be removed from Glens Falls to Albany.

MONROE, N. Y.—The Orange & Rockland Electric Company will organize with $50,000 capital stock. A central generating plant will be established in Monroe and current will be furnished for lighting Monroe, Chester and surrounding villages. The directors hope to have the plant in operation early in July.

BATAVIA, N. Y.—F. A. Dudley, a director of the Niagara Falls Power & Transmission Company, addressed the Board of Aldermen in regard to granting a franchise to his company for the purpose of furnishing power for light and other purposes. He said he could not promise to have a transmission line completed for at least a year. The cost of this line is to be $1,000,000, he said.

ALBANY, N. Y.—The Common Council has passed a resolution providing for the appointment of a committee of five to investigate the subject of a municipal lighting plant, also to appropriate the money to carry on the investigation and employ an electrical expert. It is estimated that the cost of constructing such a plant will be $296,000 and the operating expenses $121,000 per annum.

ALBANY, N. Y.—Assemblyman Leggett, of Niagara County, has informed the representatives of the Niagara, Lockport & Ontario Power Company that under no circumstances will he allow its Charter Amendment Bill, now pending before the Committee on Electricity, Gas and Water Supply, to be reported out unless the company agrees to accept his clause in the bill limiting the amount of water to be taken from the Niagara to 400,000 horse-power.

DALLAS, N. C., is installing a new lighting system, the power to be furnished by the Dallas Cotton Mills.

SPENCER, N. C.—The town of Spencer will vote in May on the question of a $70,000 bond issue for electric lights, water and other improvements.

CHARLOTTE, N. C.—The City & Suburban Electric Company, of Charlotte, has organized with a full board of directors and officers, with B. D. Heath, president, and P. M. Brown, secretary and treasurer, both of Charlotte.

GRAND FORKS, N. D.—The citizens have voted to issue $30,000 of bonds for the construction of a municipal electric light plant.

READING, OHIO.—The citizens have voted to issue $28,000 electric light bonds.

DAYTON, OHIO.—The Dayton Electric Light Company and the Montgomery County Electric Light Company have been consolidated as the Dayton Lighting Company. Stockholders: Dr. J. E. Lowes, R. A. Deweese, J. C. Reber and H. C. Kiefaber, of Dayton, and A. M. Young, Anthony Brady and H. S. Runkle, of New York. New equipment has been ordered.

GUTHRIE, OKLA.—The Guthrie Electric Light Company has received two 250-hp engines with boilers, stacks and appurtenances. A new engine with three generators for the street railway power plant, with switchboard and panels, is expected within a few days.

WELEETKA, OKLA.—Mr. L. Moore and G. F. Clark expect to develop at Weleetka within the next year a water power establishment on the Canadian River. In addition to Weleetka, Messrs. Moore and Clark have interests all the way between the Oklahoma line and Arkansas.

PORTLAND, ORE.—The Portland General Electric Company is spending $300,000 in enlargements and improvements of a permanent nature, as a result of the Lewis and Clark fair and the growth of the city.

PITTSBURG, PA.—Plans are being prepared by the architects of the new Carnegie Technical School for a temporary power house to be located at the top of the hollow.

PHILLIPSBURG, PA.—The Gas, Light, Heat & Power Company will increase its station capacity by the addition of a 300-kw generator, a motor-generator set consisting of a 300-hp motor and a 200-kw generator, and two direct-current machines of smaller size. Four 75-kw 2200 volt transformers, lightning arresters, choke coils, regulating transformers, switchboard, and arc lamps are also included in the order, which was obtained by the Westinghouse Electric Mfg. Company.

EDGEFIELD, S. C.—The question of constructing water works and an electric light plant is under consideration here.

NASHVILLE, TENN.—It is reported that improvements amounting to $100,000 will be made at once at the power plant of the Nashville Railway & Light Company. Three large boilers and a new generator have been ordered for the big plant on Cumberland River.

DICKSON, TENN.—The town of Dickson has voted $6000 bonds for a municipal electric light plant. The Mountain Island mill and water power company, located at Mountain Island, N. C., has been sold to a company headed by Dr. Gil Wylie, of New York, president of the Catawba Power Company. The purchase price is given at $200,000.

KNOXVILLE, TENN.—It is calculated that 30,000 horse-power will be developed by the Knoxville Power Company at its plant. All of the power plants in Knoxville at present use only 15,000 horse-power, but the city is growing. The amount, which it is known can be developed at the dam, will exceed the total horse-power used in Knoxville at present by 100 per cent.

LOGAN, UTAH.—Shepherd, Monson & Schaub have decided to install a power plant of 500 horse-power in Cache County.

ST. JOHNSBURY, VT.—The village trustees have signed a contract with the St. Johnsbury Electric Company to furnish street lights for the year 1905 at the old price, $64.60 a light.

CAPE CHARLES, VA.—I. J. Burbage, Town Clerk, writes that no bids were received April 3 for the electric light franchise, and the time for receiving bids was extended for 60 days.

TACOMA, WASH.—A. McL. Hawkes has submitted a proposition to the city to construct an electric power plant for $600,000.

KELSO, WASH.—The Kelso Water & Light Company proposes to construct an electric light plant at a cost of $10,000, but the company is not yet ready to consider bids. C. P. Henricksen is the engineer.

BERKELEY SPRINGS, W. VA.—A charter has been granted to the Berkeley Springs Light & Water Company with a capital of $25,000. The incorporators are: Henry N. Hanna and Eugene L. Norton, of Baltimore, Md.; J. Frank Field, Hancock, Md.; H. T. B. Dawson, of Berkeley Springs, and others.

STOUGHTON, WIS.—The citizens have voted to issue $25,000 for a municipal lighting plant.

KENOSHA, WIS.—Mayor Jas. Gorman has begun a movement in this city to secure a municipal lighting plant. The present contract expires in two years.

GRAND FALLS, B. C.—The Grand Falls Power Company has been incorporated with a capital of $200,000 by Sir Wm. C. Van Horne, of Montreal, Que.; Hugh Havelock MacLean, of St. John, N. B.; Frank C. Partridge, of Proctor, Vt., and others, to construct and operate a canal and hydraulic raceway at Grand Falls.

NUEVO LAREDO, MEX.—A company is being formed by Octaviano Gonzalez and associates with a capital of $30,000, to construct an electric light plant at Nuevo Laredo.

AROOSTOOK FALLS, N. B.—A bill to give the Maine & New Brunswick Electrical Company an exclusive franchise of Aroostook Falls, N. B., has passed the corporation committee of the New Brunswick Legislature. The company must expend $25,000 upon its works in New Brunswick within the year. Electrical power must be furnished to patrons in New Brunswick, at any time as cheaply as it is sold to Maine customers, and the company will be required to pay the province an annual rental for the privilege, of $250, until such time as the gross earnings of the company reach $25,000 per annum, then two per cent. upon the earnings thereafter.

NORTH SYDNEY, N. S.—The Town Council has endorsed the move on the part of the Snyder Mines Electric Company to seek a charter to operate in North Sydney. The new company offers to provide electric light at 11 cents per kilowatt-hour, as against 15 cents at present charged by the Cape Breton Electric Company in the town.

MORRISBURG, ONT.—Two important by-laws have just been ratified by the ratepayers. They provide for the development by the town of a 1000-hp hydro-electric plant for the purpose of furnishing power to factories and the granting of free power, light and water to J. Wesley Allison, of New York, for establishing a tin plate and sheet industry.

OTTAWA, ONT.—A special meeting of the City Council of Ottawa considered the situation created by the passing in the House of Commons, of the bill allowing the Ottawa Electric Company to purchase the bonds, stock and debentures of the Consumers' Electric Company, and which puts an end to competition in the city in electric lighting, creating a monopoly and consequently raising lighting rates to 40 per cent. more than is now charged. The Council unanimously resolved to submit to the property owners of the city a by-law enabling the city to buy out the Consumers' Company. The charter of that company contains a clause giving the city the power to buy it out at any time, the price to be fixed by arbitration and no allowance to be made for the unexpired term of the franchise. The city some time ago obtained from the provincial legislature the power to borrow $250,000 to set up a municipally-owned and operated plant if the ratepayers so desired. This sum would now be available for the purpose of taking over the Consumers' plant.

CHARLOTTETOWN, P. E. I.—It is proposed to apply to legislature for permission to construct an electric light plant at a probable cost of $75,000. W. W. Clark is city clerk.

MONTREAL, QUE.—The Richelieu Light & Power Company, with an authorized capital of $500,000, has been formed by several Montreal financiers, and is now seeking incorporation from the government at Ottawa. The company proposes to supply the towns of Farnham, St. Cesaire, Iberville, St. Johns and many other adjacent towns in Quebec province, with electricity for light and power purposes. A plant on the Yamaska has been acquired which it is proposed to enlarge.

The Electric Railway.

HUNTSVILLE, ALA.—It is rumored that the Huntsville Railway, Light & Power Company, controlled by T. C. DuPont and J. H. Waters, of Wilmington, Del., will shortly pass into the hands of a corporation contemplating extensive improvements.

CANAAN, CONN.—The Berkshire Power Company is building a plant on the Housatonic River, which will probably be in operation in six or eight weeks.

ALTON, ILL.—The statement is authorized by Big Four officials that the road is considering a plan to equip as an electric railway the branch between Alton and East Alton, as a means of reducing operating expenses.

BUNKER HILL, ILL.—At a meeting of the business men of Bunker Hill an organization of an electric railway between East Alton and Litchfield was effected. The following officers were elected: President, J. H. Belt; vice-president, Charles E. Drew; secretary, H. R. Rudd. When completed the line will extend from Litchfield to East Alton. Cars will run direct into St. Louis.

BLOOMINGTON, ILL.—The Springfield & Northeastern Railroad Company will build between Springfield, Lincoln and Bloomington, and operate twenty cars. The company has organized as follows: Lafayette Funk, of Bloomington, president; S. E. Pratteur, of Bloomington, vice-president; Frank W. Aldrick, of Bloomington, secretary and treasurer; L. E. Myers, of Chicago, general manager; W. H. Evans, of Lincoln, superintendent; C. E. Collins, of Chicago, chief engineer.

FORT WAYNE, IND.—The Fort Wayne, Van Wert & Lima Traction Company has let all the contracts for material and construction necessary to complete its interurban line from Van Wert into Fort Wayne, has given orders to rush the work of construction as rapidly as possible, and is planning to begin active operation April 15.

INDIANAPOLIS, IND.—A second belt railway, encircling Indianapolis far beyond the tracks of the Union Railway Company's belt line, is now proposed by the men back of the Indianapolis, Toledo & New Castle Electric Railway Company, which was recently granted a franchise to the city over a private right of way. The proposed line will be constructed so as to accommodate steam trains, but is intended for electric service.

CLINTON, IA.—Col. U. M. Hord is interested in a projected electric railway to Fort Dodge.

SUMNER, IA.—The officials of the Waterloo & Cedar Falls Rapid Transit Company announce that they intend to construct about 60 miles of new road this summer. This company operates an electric interurban railway between Waterloo, Cedar Falls and Waverly, Ia., and a steam road between Waverly and Sumner.

OTTUMWA, IA.—A plan is on foot to connect Ottumwa and Des Moines by an electric railway. Attorney A. A. McGarry and J. N. Casady, of Des Moines, are interested. The proposed line will be about 80 to 85 miles in length and will touch the coal fields of Marion, Mahaska, Monroe and Wapello Counties.

IOWA CITY, IA.—The directors of the Cedar Rapids & Iowa City Interurban Railway Company have decided to extend the line from Iowa City to Muscatine, a distance of 39 miles, and to complete the extension this year if possible. The construction work will be done under the name of the Iowa City & Eastern Railway Company, which was organized last year by practically the same parties who control the Cedar Rapids & Iowa City line.

LAKE CHARLES, LA.—The Lake Charles Street Railway Company will begin the active construction of an electric railway not later than April 15. Surveys are nearly completed and all orders for material will be placed in the next few days.

CUMBERLAND, MD.—De Warren H. Reynolds, as president of the Westernport & Lonaconing Electric Railway Company, has acquired a controlling interest in the Cumberland & Westernport Electric Railway, which runs between Cumberland and Lonaconing, a distance of 22 miles. The roads will be consolidated, and the service entirely harmonized.

LYNN, MASS.—The right to incorporate has finally been granted to the Nahant & Lynn Street Railway, which plans to build an electric railway between Nahant and Lynn. Walter H. Southwick, of Lynn, is the chief promoter.

BOSTON, MASS.—The Worcester Consolidated Street Railway Company has petitioned the railroad commissioners for a reduction in the price at which it may issue new stock already authorized but held in the treasury. The commissioners in October, 1901, authorized the company to issue 4450 shares of new stock and in August, 1902, an issue of 3500 more shares was authorized, both issue to be sold to stockholders at $116 per share.

NILES, MICH.—The Niles City Council has passed the ordinance granting the South Bend & Southern Michigan Railroad Company a franchise to build a line through the city.

KALAMAZOO, MICH.—At a meeting of the board of directors of the Grand Rapids-Kalamazoo Valley Electric Road a contract was signed with the Westinghouse Manufacturing & Electric Company, for the construction of the road; work to begin at once.

GRAND RAPIDS, MICH.—The contract for equipping the Grand Rapids & Kalamazoo Railway provides for the installation of the Westinghouse single-phase system. The road will be about 60 miles long. Twelve passenger cars, to be geared for high speed, and six fast express cars have been ordered. The road will use the city lines of the Michigan Traction Company for a terminal in Kalamazoo. The location of the central power house is not even intimated in the information to hand. The board of directors consists of W. H. Patterson and Frank Henry, of Kalamazoo; E. J. Anderson, of Plainfield; C. B. Kelsey and George Hefferan, of Grand Rapids. The company is financed by

eastern capital. Ex-Senator John J. Patterson, of Philadelphia, who is chief promoter of the company, has been elected president of the Michigan Construction Company, specially organized to take charge of the construction of the road.

FARMINGTON, MO.—The St. Francois Electric Railway has organized as follows: President and treasurer, A. J. Zwart; vice-president, C. H. Bosworth; secretary, F. L. Thompkins.

KANSAS CITY, MO.—The Kansas City & Leavenworth Electric Railway, 30 miles long, connecting the cities named, has been sold in Cleveland to Clarence S. McClelland, of Mount Vernon, N. Y., who represents an eastern syndicate. The line will be extended to Atchison, Kan., and St. Joseph, Mo.

ITHACA, N. Y.—The State Board of Railroad Commissioners has authorized the Ithaca-Cortland Traction Company to increase its capital from $200,000 to $1,000,000.

SCHENECTADY, N. Y.—The Schenectady Railway Company, now controlled by the New York Central Railroad, will construct another interurban line this summer, in addition to its Saratoga and Cohoes extensions.

COHOCTON, N. Y.—The town of Cohocton, Steuben County, N. Y., and the town and village of Naples, Ontario County, N. Y., have granted franchises to Geo. H. Switzer, of Bath, N. Y., to build a 10-mile electric railway from Atlanta to Woodville, at the head of Canandaigua Lake.

SYRACUSE, N. Y.—The Syracuse Lighting Company will soon sign a contract with the Syracuse & South Bay Railroad Company to supply it with power necessary to operate the double-track high-speed electric railway between Syracuse and Oneida Lake, now in course of construction.

NEW YORK, N. Y.—From three to five special trains are now being run during the rush hours of the morning and in the afternoon in the subway, in addition to the regular express trains. This new service, while irregular before the strike, has been introduced as a permanent feature of the improvements which the company expects to give to the public.

MIDDLETOWN, N. Y.—Contracts have been let for the remodeling of the power plant of the Middletown-Goshen Traction Company. The Harrisburg Engine Company will install new engines. The Bullock branch of the Allis-Chalmers will supply two new generators. New boilers will also be installed. It is stated that the present equipment of the plant will be sold.

NEW YORK, N. Y.—The Brooklyn Rapid Transit Company has asked the Rapid Transit Commission for extensive alterations in and additions to the routes for Brooklyn subways and Manhattan connections. Should the Brooklyn Rapid Transit obtain routes in Manhattan such as are suggested, it would, it is said, compete seriously in local traffic with the Manhattan companies.

NEW YORK, N. Y.—The Legislature has been asked to give the New York City Rapid Transit Board authority to grant a franchise to any railroad company organized to construct a tunnel railroad or railroads in the city of New York for the transportation of freight. The object is to bring about the construction of freight tunnels in New York City similar to those constructed in Chicago.

LONG ISLAND CITY, N. Y.—The Long Island Railroad has received the first of its electric locomotives for use on the portions of the system which are being converted for operation by electricity. The new engine has in the last few days been employed on the lines leading out toward Manhattan Beach, which have been equipped for the overhead trolley by the Brooklyn Rapid Transit Company. The locomotive is adapted for operation either by the overhead trolley or the third-rail system.

COSHOCTON, OHIO.—Dr. John Shrontz and W. Baird, of Martinsburg, are promoting an electric railway from Coshocton to Mount Vernon by way of the Walholding Valley.

LORAIN, OHIO.—The Lorain & Eastern Railway, which is the name of the new spur line to be built by the Lake Shore Electric interests, has a franchise pending before the Lorain Council.

BLOOMDALE, OHIO.—S. P. Douglass, of Toledo, president of the Fostoria, Bloomdale & North Baltimore Traction Company, has applied for a franchise in Bloomdale. The company proposes to build from Fostoria to Deshler.

FOSTORIA, OHIO.—The Westinghouse Electric & Manufacturing Company is preparing plans for the equipment for a 12-mile traction line to be built from Fostoria to Bloomdale. S. P. Douglas, of Toledo, is president of the company.

TOLEDO, OHIO.—The Toledo Southern Traction Company has been incorporated with a capital stock of $100,000 by George B. Kerper, Willard F. Robinson, Thomas H. Tracey and Charles F. Chapman, Jr. The company proposes to build from Toledo to Greenville, Ohio.

DAYTON, OHIO.—The Dayton & Northeastern Railway Company, of Dayton, has been incorporated with a capital stock of $100,000, by Hugo Cook, W. W. Chambers, J. J. Hall, F. W. James and W. W. Shuey. The company proposes to build a line from Dayton to Kenton.

LIMA, OHIO.—The extension of the Western Ohio Railway from Lima to Findlay, has been organized as the Lima, Findlay & Toledo Railway Company. The company will have a capital stock of $900,000. The bonds have been sold to Denison, Prior & Company, of Cleveland.

LIMA, OHIO.—The Lima, Delphos, Van Wert & Fort Wayne Traction Company has been consolidated with the Fort Wayne, Van Wert & Lima Traction Company. The company has a capital stock of $2,000,000. The first-mentioned company was formed to build the section of the line in Ohio.

CLEVELAND, OHIO.—There is considerable talk in local financial circles of the formation of a company to consolidate the four lines operating between Cleveland and Erie, Pa., as follows: Cleveland, Painesville & Eastern; Cleveland, Painesville & Ashtabula; Ohio & Pennsylvania, and Conneaut & Eastern.

WAPAKONETA, OHIO.—G. B. Smith, secretary of the Sandusky Southwestern Traction Company, which is in the hands of a receiver, has called a meeting of the stockholders for the purpose of taking the road out of the receiver's control. It is stated that eastern capitalists have agreed to finance the enterprise if this is done.

MANSFIELD, OHIO.—The Mansfield Railway, Light & Power Company is preparing to revamp its power station and has placed a contract with the Allis-Chalmers Company for lighting and railway apparatus, including three engines, one 250-k.w. Bullock generator, one 500-k.w. and one 600-k.w. railway generator and one 125-h.p. motor and one motor generator set.

DAYTON, OHIO.—The Dayton & Xenia Traction Company is planning to build a cut-off from a point on its line near Alpha to a point on the Springfield & Xenia Traction Company's line. In connection with the last-mentioned company, cars are now being operated through from Dayton to Springfield, and the cut-off would cut out the route through Xenia and reduce the running time considerably.

MANSFIELD, OHIO.—The Wooster & Mansfield Electric Railway Company has been formed with R. H. Critchfield, president, and David Collier, secretary. They propose to build a line from Wooster to Mansfield and are endeavoring to obtain financial assistance in towns along the line. They are considering the advisability of adopting a gasoline motor car, which Philadelphia people are anxious to exploit.

TOLEDO, OHIO.—The Toledo, Port Clinton & Lakeside Railway Company has placed contracts for steel, ties and overhead equipment for its extension to Lakeside. Work has been started. The company has not yet decided where it will locate its new power station, as three towns are in competition for the plant and car shops. Plans for the buildings have been completed, and contracts have been let for the power equipment.

COLUMBUS, OHIO.—The Columbus, Delaware & Marion Railway Company has placed contracts with the General Electric Company for three 2000-kw Curtis turbo-generators. One of them is to be installed within six weeks at the company's power station at Stratford, which is being enlarged for the purpose. The generators will produce 370-volt 25-cycle current, which will be stepped up to 33,000 volts for the transmission lines. Three sub-stations already constructed are being equipped with rotaries and transformers which have been on hand for some time.

CINCINNATI, OHIO.—The stockholders of the Cincinnati, Dayton & Toledo Traction Company have confirmed the action of the directors, turning that property over to the Northern Traction Company, which will take possession of the entire plant. The stockholders also voted an issue of $250,000 in preferred stock, to be utilized in lifting the floating indebtedness of the Cincinnati, Dayton & Toledo. The new corporation, which was recently organized to run traction lines in 18 counties in western Ohio, binds itself to spend $1,500,000 on the property within two years in improvements. Besides the interurban lines, all the street car lines in Hamilton come under the control of the new corporation.

SCRANTON, PA.—Negotiations are said to be pending for the purchase by the United Gas & Electric Company, of New York, of the local electric light companies, the Scranton Gas & Water Company and the Scranton Street Railway Company.

CORRY, PA.—The Northeast & Findlay Lake Street Car Company has been incorporated at Albany with a capital stock of $130,000. J. H. Nichols, of Titusville, is the promoter. This is the line that is fighting the Corry, Findlay Lake & Northeast road for a Pennsylvania charter.

YORK, PA.—The York & Susquehanna Street Railway Company has been incorporated with a capital stock of $84,000, to build an electric railway through the villages of Green Hill, Longstown, Yorkana and East Prospect, terminating at Long Level. William Hall is the president of the company.

HARRISBURG, PA.—The Cumberland Valley Railroad has purchased the right and franchises of the Chambersburg & Gettysburg Electric Railway Company and will complete the line to Gettysburg, the State Forestry Reservation at Graffensburg and other points. The railroad company will, it is stated, run electric cars to and from Waynesboro, using the tracks over which the steam cars now run.

WEST CHESTER, PA.—The West Chester Street Railway Company has filed in the Recorder's office plans for three extensions. One is from West Chester to Coatesville, a distance of 14 miles; the second is from Willowdale to London Grove, and the third is from High Street, West Chester, to Wilmington, Del. In addition to this it is given out that work will be resumed on the line between here and Pottstown next month. Work has been started on the Oxford, West Grove and Avondale line.

CHARLESTON, S. C.—The Southern Railway Company is reported to have arranged to install a motor car service on its line between Charleston and Summerville. The Charleston & Summerville Electric Railway is planning to build an electric railway between Charleston and Summerville and has awarded contracts for construction.

PIERRE, S. D.—A move in the direction of building an electric railway in Sioux Falls, which has been under consideration for some time, has resulted in the filing with the Secretary of State of articles of incorporation of the City Railway Company, with headquarters at Sioux Falls, and a capital of $500,000. The incorporators are: J. R. Sheeley, of Osceola, Ia.; G. W. Rhine and Tore Tiegen, of Sioux Falls, S. D. The purposes of the corporation as set out in the articles of incorporation are to construct a city and suburban electric railway and to sell electric power for manufacturing purposes. The proposed line is to be 20 miles in length, and to operate out of Sioux Falls into the counties of Minnehaha, McCook, Turner, Laje and Moody, in South Dakota, and the counties of Rock, in Minnesota, and Lyon, in Iowa.

NORFOLK, VA.—The Seaboard Traction Company has applied to the Council of Portsmouth for rights of way for an electric railway which will run from Smithfield to Portsmouth and Suffolk, and thence on through Petersburg to Manchester, opposite Richmond. L. R. Britt, of Norfolk, is president of the company.

WALLA WALLA, WASH.—To construct and operate an electric railway from Walla Walla to Wallula is the object of the Inland Empire Traction Co. A number of prominent Walla Walla men, headed by George W. Armour, late of the Holt Manufacturing Company, have been at work on the plans for several months. Power has been arranged for from the Northwestern Gas & Electric Company.

MANILA, PHILIPPINE ISLANDS.—The electric street railway was formally opened here for traffic.

New Industrial Companies.

THE COOPER HEWITT COMPANY, of Louisville, Ky., has been formed to deal in the general electric supplies and other electrical specialties by L. H. Cooper and H. B. Hewitt.

THE TATEM MFG. COMPANY, of New York, has been formed for the purpose of manufacturing telephone apparatus; capital, $5,000. Incorporated by D. B. Tuttle, C. J. Ellis and others.

THE TELEPHONE WOOD WORKING COMPANY, of Tiffin, Ohio, has been incorporated with a capital stock of $50,000. The incorporators are W. H. Roose, John A. Belford, John R. Calder, T. C. Averill and Fordyce Belford.

THE DINKINS ELECTRIC COMPANY, of Indianapolis, capital $15,000, has been organized for the purpose of manufacturing machinery of all kinds. Directors: Z. E. Dougan, Henry Hadley, J. H. Hall, A. R. Morley and J. M. Dinkins.

THE TIDEWATER CONSTRUCTION COMPANY, Suffolk, Va., has been incorporated by W. H. Robinson, of Norfolk, president; G. L. Barton, of Suffolk, Va., secretary and treasurer. It will build railroads, power-houses, bridges, etc.

THE RALEIGH CONSTRUCTION COMPANY, of Raleigh, N. C., was recently organized under the laws of North Carolina to do all kinds of electrical work. The officers of the company are: President, A. L. Murray; treasurer, J. A. P. Farnham. The manager is Mr. T. G. Birtwhistle.

THE ELBA ELECTRIC POWER COMPANY, of Elba, Ala., with a capital stock of $30,000, has filed a notice of its incorporation. The business of the company is the generation of electric power for sale and use in industrial and manufacturing enterprises and lighting of municipalities. The incorporators are Y. W. Rainer, J. B. Amos, J. N. Hone, Jr., Mrs. A. E. Wright, B. W. Page, J. D. Lee, J. J. Maddox, A. D. Donaldson, W. B. Perdue, A. T. Bryan, B. F. Conner, John M. Garrett, J. B. Simmons, J. H. Rowe, W. P. Boyd and Z. W. Rainer

Legal.

CHICAGO UNION TRACTION.—A despatch from Chicago states that a judgment has been rendered against Union Traction in favor of the Northern Trust Company for $80,000 on unpaid notes. Execution against the property has been issued, but no property can be seized to satisfy the claim.

STATE TELEPHONE COMPANY, NEW JERSEY.—Vice-Chancellor Grey has signed an order requiring the State Telephone Company to show cause why a receiver should not be appointed to take charge of its affairs. The application was made by J. Pratt Cramer, of Atlantic City, and George H. Kinney, of Collingswood, N. J., holding respectively $24,000 and $5000 of the bonds of the company on which the payment of interest had been defaulted. The bill states that the physical property of the company, so far as the complainants have been able to discover, consists of a line from Jersey City to Camden, with various branches. Diligent inquiry, they say, has failed to discover any operating office of the company in the State.

Obituary.

MR. W. B. TURNER, formerly general superintendent of the Schenectady Edison Works, died March 26 at Hot Springs, Arkansas. Mr. Turner, who was familiarly known among his friends as "Pop" Turner, was with the Edison Machine Company when its works were removed to Schenectady, and was superintendent of the Schenectady plant until 1892. In 1894 and for several years subsequently he was connected with the Chicago Edison Company. Of late his home had been at South Bend, Ind. A widow and daughter survive him.

Educational.

PURDUE UNIVERSITY.—From the 1904-1905 catalogue of Purdue University it is learned that the number of graduates in electrical engineering in June, 1904, was 56, and the number of electrical engineers to be graduated in June of this year will be 65. The University offers courses in electrical, mechanical and civil engineering, science, agriculture and pharmacy. The number of students in attendance in the school year 1904-5 was 1528, representing 36 States of the Union and 10 foreign countries. Of the total enrollment, 410 were students of electrical engineering. The Freshmen class, by far the largest in the history of the University, numbered 461 students; the sophomore, 389; Junior, 261, and Senior, 203; post graduates, 28; students of pharmacy and special students, 81. The number of professors, instructors and assistants in the faculty last year was 109.

POLYTECHNIC INSTITUTE OF BROOKLYN.—The catalogue and register of the Polytechnic Institute of Brooklyn for 1904-1905, shows that since the year 1854 in which it was established, there have been graduated 646 students, and that the present enrollment includes 98 students, The instructing force consists of 24 professors, assistant professors, instructors and assistants. The schedule of courses includes arts, chemistry, civil, electrical and mechanical engineering. For those taking electrical engineering, the work of the senior year involves courses in diffential equations, in alternating currents, in the electric railway, in the telephone, in electro-metallurgy, in long-distance transmission, in frame structures, in the laws of contracts, in electrical design, in electric lighting, with practice in the alternatiing-current laboratory and with thesis work extending throughout the whole school year.

Personal.

MR. W. K. PALMER, Kansas City, Mo., has completed plans and specifications for a hydro-electric plant for the Kingman, Kan., Light & Power Company, to be located on the Ninnesoah River.

MR. D. B. RUSHMORE has been transferred from the works of the Stanley Electric Company, Pittsfield, Mass., to the railway engineering department of the General Electric Company, at Schenectady.

MR. ARTHUR S. IVES, for some years in charge of the centrifugal pump department of R. D. Wood & Company, of Philadelphia, resigned March 11 to become assistant general manager of the Glamorgan Pipe & Foundry Company, Lynchburg, Va.

MR. GARDINER C. SIMS has acquired an interest in the Marine Engine & Machine Company, which will take up the manufacture under his supervision as general manager of the works, the manufacture of the well-known type of Armington & Sims engine.

MR. W. L. WOOD, JR., formerly with the General Electric Company, and for the past year connected with the Electrical Supply Company, of Memphis, Tenn., will take charge of the Texarkana Electric Light, Gas & Street Railway properties at Texarkana, Ark.

MR. GEORGE A. DAMON, managing engineer of the Arnold Company, Chicago, will lecture on "Engineering as a Career," in a series of lectures given by the Y. M. C. A. in Chicago this year, in which course prominent men in various professions in Chicago will appear.

MR. ROBERT STUART STEWART has established offices in the Penobscot Building, Detroit, Mich., for practice as a consulting electrical engineer. Mr. Stewart's specialties are electric railway, lighting and power systems, factory equipments and special investigations.

MR. RICHARD DEVENS, who has for some years been connected with the European office of the Brown Hoisting Machinery Company, Cleveland, Ohio, has been appointed manager of its New York office, 26 Cortlandt Street, to succeed Mr. W. A. Stadelman, who has resigned.

MR. CHARLES H. WILLIAMS, president of the Northwestern Electrical Association, has been appointed general manager of the Wisconsin Light & Power Company, La Crosse, Wis. Mr. Williams has severed his connection with the Madison Gas & Electric Company as its superintendent.

MR. LOUIS B. MARKS has associated himself with Mr. Henry Floy, in consulting engineering work, with offices in the St. Paul Bldg., New York. Mr. Marks will make a specialty of illuminating engineering for which he is particularly qualified, having from the time of graduation devoted himself to the study of light sources and illumination. Mr. Marks has just received the appointment of illuminating engineer for the new buildings of the College of the City of New York .

Trade Publications.

PAISTE SPECIALTIES.—The H. T. Paiste Company, Philadelphia, is sending out circulars illustrating and describing "Little Keystone" rosettes and a new "Fielding" receptacle.

CONSTANT-SPEED MOTORS.—Circular 10 of the Electro-Dynamic Company describes and gives the dimensions and prices of its type I, constant-speed motor, which supplements the company's line of variable-speed, interpole motors.

ALBERGER CONDENSING APPARATUS.—In catalogue No. 5, the Alberger Condenser Company illustrates and describes its latest type of high vacuum apparatus, consisting of dry vacuum pumps, barometric and surface condensers. The Alberger cooling tower and centrifugal pumps take up the final pages.

INDUCTION INTEGRATING WATTMETERS.—The Fort Wayne Electric Works has reprinted in pamphlet form the interesting paper, entitled "Notes on Induction Integrating Wattmeters," read last fall by Mr. A. A. Serva at the second annual meeting of the Colorado Electric Light, Power and Railway Association.

CHURCH LIGHTING BY ELECTRICITY.—With this title the Nernst Lamp Company has issued a handsome pamphlet illustrating views of church interiors illuminated by Nernst lamps, and appointing out the particular advantages of the lamp for this service.

THEATRE DIMMERS.—The Wirt Electric Company, Philadelphia, devotes its Circular No. 316 to the Wirt theatre dimmer, which is illustrated in a number of forms, and several views are given of complete theatre installations. One of the claims for this dimmer is for its rugged character, which enables it to withstand the hardest usage.

VULCAN GRATES.—A. D. Granger Company, New York, in its bulletin No. 4, illustrates and describes in detail the several types of Vulcan shaking and dumping grates, which are built to fit any size of furnace, and to any style of front and all types of boilers.

RAPID MECHANICAL CALCULATION.—With this title the Felt & Tarrent Manufacturing Company has issued a catalogue describing the new model "Comptometer," and enumerating some of the numerous uses to which it has been applied, including central station accounting.

BUFFALO FORGES AND BLOWERS.—The extent of the line of forges and blowers manufactured by the Buffalo Forge Company is made strikingly evident in the 1905 edition of its catalogue (No. 167) which numbers 104 pages, containing more than 150 illustrations of different apparatus.

PIONEERS AND LEADERS.—With this title the New York Belting & Packing Company has issued a handsome pamphlet giving numerous views of its extensive New York offices. From the text we learn that the company has passed its fiftieth year in business, that at present it has 1000 employees, and its manufactory and selling plant includes 17 buildings.

KELLOGG INTERIOR TELEPHONES.—The Kellogg Switchboard & Supply Company devotes Bulletin No. 15 exclusively to intercommunicating telephone systems. The various types and details are very completely described and adequately illustrated. The final pages contain diagrams of intercommunicating circuits which will be found of value to those interested in such matters.

"THE OLD WAY."—This title of a catalogue issued by the Edmondstone Company, 105 Chambers St., New York, derives its point from an enticing female figure on the front cover in the act of calling through her hands as a trumpet to one at a distance. The text is illustrated with scenes representing different uses of the telephone, and cuts showing in detail the various apparatus made by the company.

STURTEVANT GENERATING SETS.—In Bulletin No. 63 the B. F. Sturtevant Company shows a line of electrical generating sets, ranging in capacity from 3 to 100 kw. The engines are of both the vertical and horizontal types, but in both cases are completely enclosed and arranged with watershed partitions to prevent the water from the piston-rod boxes reaching the interior of the frame. Forced lubrication is also applied to every set.

TELEPHONE AND ANNUNCIATOR PRACTICE.—With this title the Electric Gas Lighting Company, Boston, Mass., has issued a handsome catalogue, the sub-title being "A Few Examples of Representative Installations. Instructive. Explanative." The first section of the catalogue is devoted to annunciators, followed by about an equal portion to "annunciphones," combining the annunciator and telephone systems. The remainder is given up to illustrations and descriptions of telephone apparatus and switchboards, and of recent large installations made by the company.

CHLORIDE ACCUMULATORS.—Bulletin No. 88 of the Electric Storage Battery Company, Philadelphia, Pa., illustrates and describes an installation of chloride accumulators for the Edison Electric Company, of Los Angeles, Cal. The first installation was made in one of the Los Angeles sub-stations in 1900, and consisted of 140 cells, each containing 31 plates. A second installation was made in 1904, consisting of 140 cells, each of 35 plates, capable of discharging 3,500 amperes on each side of the three-wire system. The illustrations show clearly the details of the installation.

THE CENTRAL ELECTRIC CO., Chicago, is sending out to its trade a new price-list dated April, 1905. This price-list applies to the company's 1903 catalogue, and the two together make a combination which should be in the hands of everyone buying electrical material. On the title page of the price-list is shown a view of the company's new location at 207 E. Jackson Boulevard and on the back page a picture of the ruins of its old building at 264 Fifth Ave. The book contains the very latest prices in force, and the company requests that all holders of its catalogue who do not receive a copy should write for one at the earliest possible moment.

CORLISS AND PISTON-VALVE ENGINES.—The Mesta Machine Company, Pittsburg, has issued an elaborate catalogue of its manufactures in the form of a cloth-bound oblong volume, 9x12 inches in size, containing 128 pages. The coated paper used brings out excellently the beautifully executed half-tone engravings, which number little short of a hundred, about half of which are of full-page size. The Corliss and piston-valve engines take up about a third of the pages, the remainder being devoted to illustrations of the offices and works of the company, and of its long line of rolling-mill machinery. The engines built cover the simple, compound and triple-expansion types, horizontal and vertical, combined horizontal and vertical, condensing and non-condensing.

News of the Trade.

LARGE DIRECT-CURRENT GENERATORS.—The Pittsburg Reduction Company will install two Westinghouse direct-current generators rated at 2200 kw, at 500 volts and 140 r.p.m.

THE INTERNATIONAL TELEPHONE MFG. CO., Chicago, in order to better serve its increasing number of customers in Iowa, has placed Mr. J. C. Murray in charge of its business in that State, with headquarters at Des Moines.

MR. GEORGE CUTTER, whose name has been connected with Chicago ever since the early days of electric lighting, has at last deserted the "Windy City." He is now putting the finishing touches on his new factory at South Bend, where the George Cutter Company will be located after April 15.

THE WASHINGTON CARBON COMPANY has moved its plant from Washington, Pa., to Clarksburg, W. Va., and discontinued the office at Washington. The new plant has about three times the capacity of the previous one, and, as it is entirely new, the facilities for producing the highest grade of carbons are much improved.

THE NATIONAL ELECTRIC COMPANY, Milwaukee, Wis., manufacturer of Christensen air brakes and electrical machinery, will move into a new suite of offices on the 12th floor of the new Trinity Building, 111 Broadway, New York, its present quarters at 135 Broadway being too small to accommodate its increased sales organizations.

INDUCTION MOTOR ORDERS.—The United Electric Light & Power Company, of New York, has contracted for a Westinghouse motor generator set consisting of an induction motor and a 1000-kw generator with automatic regulating control outfit. On the same day the Westinghouse Company received orders for 104 induction motors varying in size from ½ to 350 hp. and aggregating 2200 hp. capacity.

THE NORTHWESTERN ELECTRICAL EQUIPMENT COMPANY, which has been established in St. Paul for some six or eight years in the motor and lamp business, has joined the National Jobbers' Association and gone into the supply business on a very large scale. The firm is already well known in the trade in the Northwestern territory as it has been handling electrical machinery and building switchboards for some years past.

THE H. W. JOHNS-MANVILLE COMPANY has appointed Mr. T. T. Lyman to the position of general sales manager of the company. The position will call for the installation of various comprehensive systems in connection with the work of its branches in Milwaukee, Chicago, St. Louis, Boston, Philadelphia, Pittsburg, Cleveland, New Orleans and San Francisco, enabling them to keep pace with the growth of the business in their respective territory, and will lead to the opening up of new territory as the interests of the company may require.

THE NILES-BEMENT-POND COMPANY has leased an entire floor in the new Trinity Building, at 111 Broadway, New York, and will be located there after May 1st. As is well known, the executive offices have been located in New York since the organization of the company under its present title. The Niles-Bement-Pond Company employs about 5,000 workmen, and has two factories in Philadelphia, one in Hamilton, Ohio, one in Plainfield, N. J., and it also owns the Pratt & Whitney Company at Hartford, Conn., thus constituting this company very much the largest builder of iron-working machinery in the world.

ACOUSTICONS IN A THEATRE.—The Hutchison Acoustic Company, 114 West 32d Street, New York, has equipped 52 seats and two boxes in the Broadway Theatre with Acousticon connection to enable deaf or partially deaf people to hear the play. Last week Wednesday night several persons, on the invitation of president Turner of the Company, attended the performance of "Florodora" to test the operation of the instruments. The results were very satisfactory. Four transmitter-receivers were placed on the stage in front of the foot-lights and these collected the sound-waves of the players' voices and transmitted them to the various hand receivers scattered throughout the auditorium.

HEATING AND VENTILATION.—The variety of conditions which may be controlled by the modern blower system of heating and ventilating is very well illustrated in the recent installation made by the B. F. Sturtevant Company, of Boston, Mass., for the New Freedom Company, New Freedom, Pa. The buildings comprise a drying room requiring relatively rapid circulation, a loom mill for which a moderate supply of fresh air is essential and an office where the maximum of comfort is demanded. The total contents are nearly 400,000 cubic feet. The apparatus is so located as to draw fresh air through a heater and force it in such proportionate amounts to the various apartments as to maintain in each case the requisite temperature.

COMPACT GENERATING UNIT.—A new vertical cross compound condensing engine built by Allis-Chalmers Company for the tannery of A. F. Gullan & Co., at Milwaukee, is giving excellent satisfaction, having been in operation for some weeks. This engine, which has cylinders of 14 and 28 ins. diameter and a 24-in. stroke, forms the driver of a 200-kw. power unit, being direct connected to a Bullock generator, which was furnished at the same time by the Allis-Chalmers Company from its electrical works in Cincinnati. Owing to the limited amount of floor space which could be allotted to the machinery, it was built in the most compact form possible. The engine occupies an area 19 feet long and 12 feet wide. Its capacity under normal load conditions is 275 horse-power, but it is capable of producing 500 horse-power, and it is now being operated at a speed of 150 r.p.m.

QUICK WORK IN RESTORING TELEPHONE SERVICE.—The modern common battery exchange of the Northwestern Telephone Exchange Company, at Mankato, Minn., which was installed in July last year, was totally destroyed by fire March 13. The fire also destroyed the storerooms of the company. The restoration of service was performed with remarkable speed. Work progressed night and day on new quarters until the morning of March 21, when local service was resumed upon a new board, and by night there were only 15 local subscribers' lines out of 400 out of service. The toll sections were not at this time completed and until 5 p. m. March 22, Mankato subscribers wishing toll connections were trunked to a temporary toll board. At this latter hour the permanent toll board was placed in service. The board was installed by the Western Electric Company. Electric work was in charge of B. H. Skinner and R. H. White. The new location required the placing of something over a block of underground conduit and the entire rearrangement of the toll lines.

THE STROMBERG-CARLSON TELEPHONE MFG. COMPANY, of Rochester, N. Y., has recently closed a contract with the U. S. Telephone Company, Columbus, Ohio, for what is claimed to be the largest toll board ever built for an independent telephone company. The equipment is to consist of the following apparatus: Eleven toll sections, of two operators' positions each, to be arranged in one line; two recording sections, of two operators' positions, arranged in one line; one rural section; one pay station and heavy users toll section (both of these sections will be arranged in one line); one test board; one chief operator's flat-top desk with a turret in the center so equipped that the chief operator can use one side and the assistant operator use the opposite side of the desk; one switching section; one messenger call box. This arrangement consists of an annunciation box having lines running to each operator's position, who can, by pressing a key, light a lamp in the call box. The lamp is covered with a lamp-cap about 1 in. in diameter with numbered opal. The cabinets are to be built of solid mahogany. This is not only to be one of the largest, but will be the most modern toll board ever built.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED APRIL 4, 1905.

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

786,257. ELECTRIC HEATER AND METHOD OF MANUFACTURING SAME; Murray C. Beebe, Pittsburg, Pa. App. filed May 14, 1900. Relates to heaters employed in electric lamps of the Nernst type. The conductor is wound upon a core, after which a plastic refractory and non-conducting material is coated over the conductor and core, the whole then bent into the desired form and the core removed.

786,316. SIGNAL SYSTEM FOR RAILWAYS; William G. Roome, Los Angeles, Cal. App. filed Dec. 19, 1904. This invention consists of means for operating an electric railway system by alternating current and also operating signalling or other devices by a direct current and having a return common to both currents.

786,320. MEANS FOR RECTIFYING ALTERNATING CURRENTS; R. Siegfried, Pittsburg, Pa. App. filed Feb. 12, 1904. Details relating to the construction of a commutator to be mounted on the shaft of an alternating-current generator.

786,323. ELECTRIC MOTOR CONTROL; William D. Stivers, Jersey City, N. J. App. filed Nov. 12, 1904. This invention relates more particularly to derricks and the like operated by electric motors. The lowering of the load producing breaking currents in the motor.

786,325. ELECTRICAL CONDENSER; Percy H. Thomas, Pittsburg, Pa. App. filed July 16, 1903. Sheets of non-conducting material have smaller sheets of conducting material, constituting the plates, placed upon them, the corners of the conducting material being passsed through slits in the non-conducting sheets and bent over to bind the sheets together. Open-work frames of non-conducting material are placed between the various plates so made up.

786,368. RAILWAY SIGNALLING SYSTEM; Joseph Lemire, Drummondville, Canada. App. filed Oct. 3, 1904. Relates to means whereby one passing train will only partially close a semaphore operating circuit, the second train travelling in the same zone will complete the circuit, or it may be completed by hand-operated means.

786,376. ELECTROGASOLENE VEHICLE; Lars G. Nilson, New York, N. Y. App. filed May 15, 1902. The vehicle is provided with a storage battery, a gasolene motor and an electric generator, and the generator may be run by the gasolene motor when the same is not required for running the vehicle for replenishing the storage battery.

786,378. MECHANICAL POWER BRAKE; Louis Pfingst, Boston, Mass. App. filed Jan. 23, 1904. The spindle of the handbrake of a trolley car may be provided by means of this invention with an electrical motor, and upon the depression of a treadle, the motor will be brought into circuit and a friction clutch actuated to connect its motor with the brake spindle.

786,379. POWER BRAKE; Louis Pfingst, Boston, Mass. App. filed July 13, 1904. The power brake may be used as a handbrake and may be hand-operated at the same time that the time power is active, the power being an electric motor combined with devices whereby its full force may or may not be applied to the brake as desired.

786,396. INDUCTION COIL; Charles Adams-Randall, New York, N. Y. App. filed Dec. 22, 1903. The core is made of iron in the form of a split tube to prevent its forming circuits, and is provided with a number of openings. The core being in the form of a cage.

786,401. CONTROLLER FOR ELECTRIC MOTORS; Thomas E. Barnum, Milwaukee, Wis. App. filed Jan. 31, 1902. Relates to means for preventing the closing of a motor circuit, after it has been opened, until after the resistance of the motor rheostat has been again cut into the circuit.

786,411. MAGNETIC CLUTCH OR SPEED-ACCELERATOR; Henry H. Cutler, Milwaukee, Wis. App. filed Aug. 5, 1903. (See page 710.)

786,412. MAGNETIC CLUTCH OR SPEED-ACCELERATOR; Henry H. Cutler, Milwaukee, Wis. App. filed Mar. 2, 1904. (See page 710.)

786,413. MAGNETIC CLUTCH; Henry H. Cutler, Milwaukee, Wis. App. filed July 2, 1904. (See page 710.)

786,414. METHOD OF POWER TRANSMISSION; Henry H. Cutler, Milwaukee, Wis. App. filed May 19, 1904. (See page 710.)

786,415. ALTERNATING-CURRENT POWER-TRANSMITTING APPARATUS; Henry H. Cutler, Milwaukee, Wis. App. filed Oct. 22, 1903. (See page 710.)

786,416. ALTERNATING-CURRENT POWER-TRANSMITTING APPARATUS; Henry H. Cutler, Milwaukee, Wis. App. filed Jan. 28, 1904. (See page 710.)

786,417. SYNCHRONOUS MOTOR WITH CLUTCH; Henry H. Cutler, Milwaukee, Wis. App. filed Jan. 22, 1904. (See page 710.)

786,418. METHOD OF VARYING THE SPEED OF THE LOAD DRIVEN BY AN ALTERNATING-CURRENT MOTOR; Henry H. Cutler, Milwaukee, Wis. App. filed May 19, 1904. (See page 710.)

786,419. SYSTEM FOR OPERATING ELECTRIC VEHICLES; Henry H. Cutler, Milwaukee, Wis. App. filed March 14, 1904. (See page 710.)

786,420. ELECTRIC SPEED ACCELERATOR; Henry H. Cutler, Milwaukee, Wis. App. filed April 22, 1901 . (See page 710.)

786,421. SYSTEM AND APPARATUS FOR MOTOR CONTROL; Henry H. Cutler, Milwaukee, Wis. App. filed March 31, 1902. (See page 710.)

786,422. SYSTEM OF CONTROLLING ONE OR MORE ELECTRIC MOTORS; Henry H. Cutler, Milwaukee, Wis. App. filed July 6, 1903. (See Current News and Notes.)

786,423. SYSTEM FOR CONTROLLING ELECTRIC MOTORS; Henry H. Cutler, Milwaukee, Wis. App. filed July 6, 1903. (See Current News and Notes.)

786,424. SYSTEM FOR CONTROLLING ELECTRIC MOTORS; Henry H. Cutler, Milwaukee, Wis. App. filed July 6, 1903. (See Current News and Notes.)

786,425. MAGNETIC CLUTCH OR SPEED-ACCELERATOR; Henry H. Cutler, Milwaukee, Wis. App. filed July 23, 1903. (See page 710.)

786,428. SELECTIVE SIGNALING SYSTEM; Rudolph C. Deuben, Chicago, Ill. App. filed May 18, 1903.

786,429. SELECTIVE SIGNALING SYSTEM; Rudolph C. Deuben, Chicago, Ill. App. filed Oct. 2, 1903.

786,444. TELEPHONE TRANSMITTER; William Kaisling, Chicago, Ill. App. filed Nov. 23, 1903.

786,472. INSULATOR FOR THE CONDUCTORS ON ELECTRIC RAILWAYS; Frank Dietrich Ward and Harry C. Furniss, Hanwell, England. App. filed July 11, 1904. The insulator block will occupy a position between the rail carrier and a base portion and will be fastened to one of them to permit it to have vertical movement while being restrained from lateral movement.

786,489. AUTOMATIC TROLLEY POLE CONTROLLER; Martin O. Dolson, Los Angeles, Cal. App. filed July 23, 1904. The trolley pole is controlled by pneumatic means and when it reaches the limit of its excursion in either direction, it automatically shifts a slide valve for controlling such pneumatic means.

786,506. MOTOR CONTROLLING SWITCH; Frederick Mackintosh, Schenectady, N. Y. App. filed Feb. 17, 1904. Details of construction.

786,518. ELECTRODE FOR ARC-LAMPS AND METHOD OF MAKING SAME; Isaiah L. Roberts, New York, N. Y. App. filed March 25, 1903. (See Current News and Notes.)

786,523. TELEPHONE RECEIVER HOLDER; Kate C. Seaman, New Orleans, La. App. filed April 9, 1904. A jointed arm is provided for holding the telephone receiver so that it may be held to the ear mechanically.

786,533. ELECTRIC EXERCISING APPLIANCE; Wesley Sutton and Samuel Lord, Liverpool, and William Sunderland Kerr, Southport, England. App. filed July 11, 1904. The handles of an exercising apparatus are provided with circuit closing means so that when both the handles are shut, the current will flow through the hand and arm of the exerciser.

786,542. ELECTRIC HEATER; Louis P. Brown and Frank J. Holmes, Chicago, Ill. App. filed Oct. 17, 1904. Details of construction of an electric heater peculiarly adapted for soldering irons.

786,552. EXERCISING DEVICE; Matthew Duffner, Allegheny, Pa. App. filed Aug. 18, 1904. A weight mounted upon a shaft is made hollow and contains a device for generating electricity and passing same to the hands of the exerciser.

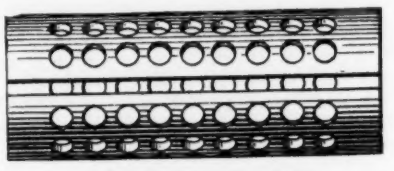
786,577. THERMO-ELECTRIC COUPLE; Albert L. Marsh, Lake Bluff, Ill. App. filed Oct. 18, 1904. (See Current News and Notes.)

786,578. COMBINED CONDENSER AND LEAK-COIL; Walter W. Massie, Providence, R. I. App. filed June 18, 1904. This invention relates to wireless telegraphy apparatus, and provides means for preventing disturbances from the local atmospheric electricity and insures the passage of all oscillatory currents to the receiving instruments.

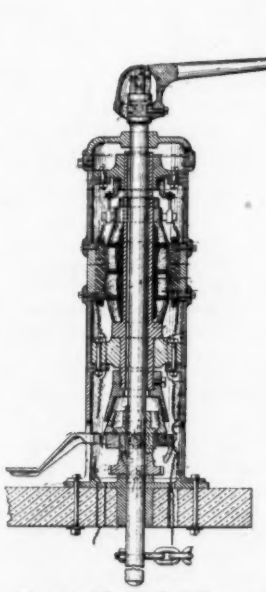
786,588. TELEPHONE RECEIVER; William J. Murdock, Boston, Mass. App. filed July 21, 1904.

786,589. CIRCUIT CLOSING AND BREAKING DEVICE; William J. Murdock, Boston, Mass. App. filed July 21, 1904. Details of construction of a push button.

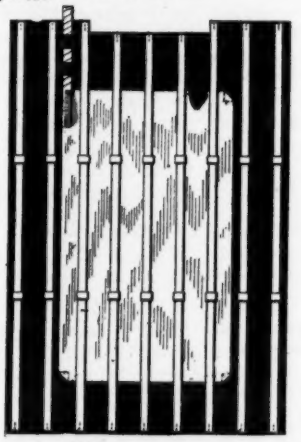
786,604. RAILWAY SIGNAL SYSTEM; William E. Schieble, Miamisburg, Ohio. App. filed May 16, 1904. This system is particularly adapted for use on interurban electric railway lines, and a car entering a block will display a signal at each end of the block.



786,396.—Induction Coil.



786,378.—Mechanical Power Brake.



786,325.—Electrical Condenser.

786,628. ELECTRIC INDICATOR FOR RAILWAYS; Pierre I. Chandeysson, North Judson, Ind. App. filed Feb. 13, 1904. The system indicates to persons located at various stations along the railway the exact location of trains between such stations.

786,635. SYSTEM OF CONTROL FOR ELECTRIC MOTORS; Arthur C. Eastwood, Cleveland, Ohio. App. filed March 21, 1904. Details.

786,688. AUTOMATIC STREET RAILWAY SWITCH; William S. Snyder and William H. Barker, Pittsburg, Pa. App. filed April 25, 1904. Details of construction.

786,690. MULTIPLE HOOD INSULATOR; Louis Steinberger, New York, N. Y. App. filed March 25, 1903. The various hoods of the insulator are mounted upon a spindle and a metallic tie surrounds the spindle and passes through apertures in the hoods.

786,691. STRAIN; Louis Steinberger, New York, N. Y. App. filed Aug. 24, 1904. The links entering the strain at opposite sides are made substantially U-shaped and a strut is placed between the limbs of each link to maintain them in parallelism.

786,696. SIGNAL-RELAY; Frederick K. Vreeland, Montclair, N. J. App. filed Nov. 14, 1904. (See Current News and Notes.)

786,709. ILLUMINATING DEVICE; Charles F. Alline, Fort Dodge, Iowa. App. filed May 23, 1904. This device is intended for use in show windows and other places for the purpose of attracting attention, and comprises a revolving support and lamps revolving on the support, in opposite direction and in unison with said support.

786,727.—APPARATUS FOR THE MANUFACTURE OF GLOWERS FOR ELECTRIC LAMPS; Francis M. F. Cazin, Hoboken, N. J. App. filed Feb. 2, 1903. The apparatus embodied in this patent permits the carrying out of a method whereby the bamboo twicks may be placed in a bell and the atmosphere exhausted, and various solutions admitted to the bell in vacuo which will permit entrance into the pores of the substance under treatment, and then without removing the bamboo or other substance, it may be treated to electrolytic action.

786,752. CIRCUIT CONTROLLING DEVICE FOR MOTORS; George W. Gilmore, Alliance, Ohio. App. filed Sept. 15, 1904. Details of construction.

786,754. TELEPHONIC APPARATUS; Alfred Graham, Denmark Hill, England. App. filed Jan. 11, 1904.

786,775. ELECTRIC MOTOR CONTROLLING APPARATUS; Lars G. Nilson, Hoboken, N. J. App. filed June 10, 1904. Provides a generator and a storage battery, whereby the battery may be charged and the generator act as a brake at the same time.